THE SURVEYOR, ENGINEER, AND ARCHITECT;

OR

LONDON MONTHLY JOURNAL OF THE PHYSICAL AND PRACTICAL SCIENCES

IN ALL THEIR DEPARTMENTS.

BY A COMMITTEE OF PRACTICAL SURVEYORS, ENGINEERS, AND ARCHITECTS, OF MUCH EXPERIENCE AND IN ACTIVE EMPLOYMENT.

ROBERT MUDIE, LITERARY CONDUCTOR.

HYDRAULIC ENGINEERING.

THIS department of the profession has, to some extent or other, occupied the attention of Engineers from the very dawn of their existence, and must have attracted the notice of rude men before they began to generalize facts, and ground the arts upon scientific bases. But, notwithstanding this, very many parts of it are still obscure, and have not received that attention which their importance deserves; for water, in whatever situation or under whatever circumstances it exists, is a highly interesting liquid, as well in the arts as in the general economy of nature. Besides its fertilizing properties, its buoyancy, its diminution of the weight of floating substances, to the exact amount of the volumes of water which they displace, the perfect mobility of its parts among each other without any positive friction, and the consequent ease with which it can be made a means of transit,—besides all these, and also its physiological uses in the economy of nature, it contains in itself the power of great steadiness and regularity, and which, if duly studied and directed, would add greatly to the accommodations of man, and his sovereignty over material nature.

As the subject of Engineering, the management of water may be conveniently divided into three principal branches: First, Fluviatile, or that which relates to flowing streams, and the improvement of their courses, seasonally or otherwise; Secondly, Littoral, or that which relates to the shores of the ocean, in the formation of harbours, the preservation and recovery of lands, and numerous other matters; and, Thirdly, Pelagic, or that which relates to the oceans and seas, and the formation and equipment of the different species of craft, by which these can be best, most easily, and most safely and expeditiously, made the pathway of nations to all parts of the globe.

In a country like Britain, which is girdled by the ocean on all sides, which abounds in streams and in uplands, upon many of the latter of which, though the seasonal rain falls copiously, much of it falls only to scourge the hills, scour the valleys, inundate the plains, spoil the navigation of the estuaries, and turn the lowlands on their shores into fens and marshes, a thorough knowledge of the principles, and skilful and diligent application of the practice of Hydraulic Engineering is a matter of the very first national importance, and one which should claim the attention of the government and the legislature, and not of them only, but of every man who has the capacity or the means of benefiting his country, in the best and most effectual way in which it can be benefited.

In many of the individual sections of this important branch of engineering a good deal has been done; but it has been done locally and by individuals or companies, or other small septs of men for their own profit in it as a job, rather than upon any public principle. Owing to some cause or other, public improvement, upon any thing like a grand systematic scale, appears to be adverse to the spirit of the British legislature and government. We say "legislature and government," because, in this case, the government is just what the legislature is pleased to will that it shall be. From the experience which we have, it is perhaps as well that the British government lets alone great public improvements; because most operations of this kind which have been done solely under the direction of government, and paid for out of the public revenue, have been very expensive in doing, and very imperfect after they were done. Generally speaking, those works have been in some way connected with the army or the navy; and as glory, not gain, is the expected return of these establishments, even to the most money-loving of nations, it is naturally to be supposed that works, whether land or marine, which are constructed on their account, should follow the general law. Government works for the general accommodation and benefit of the country have been exceedingly few, and it would probably have been as well if these few had never existed. The Caledonian Canal is one of the longest and largest of the Parliamentary works; and although we believe no objection can be taken to the line of this canal, yet the execution of it is very imperfect; and, were it not that there is a supply of water *ad libitum*, the banks and even the bottom of this canal are so leaky, that there would be a deficiency of water in summer, independently altogether of the working of the locks—and the same in winter indeed, were it not for the frost, which however seals the canal against all transit, at the same time that it stops the fissures. It is true that there was much to contend against in the nature of the soil, which consists of the debris of the adjoining mountains, and is in some places so exceedingly porous that underground winds blow freely and pretty strongly through it, and, when the cutting was first made, the arm could be thrust horizontally into it up to the shoulder, without meeting with much resistance. We do not mean to say that those to whom the execution of this extensive and laborious work was delegated are at all blameable for this; certainly, however, a thorough knowledge of every other circumstance bearing upon the making of the canal, and the utility of it after it was made, ought to have been obtained before the sanction of the legislature had been given, and the public money expended in virtue of that sanction, and therefore "according to law," and consequently not reversible without putting in motion the whole legislative machine, some of the wheels of which are understood to be so deep in the rut of ages, and remaining so doggedly there, that there is no means of starting them but by golden levers. Indeed it is the cumbrous and unwieldy structure of this machine, its terrible inertia, and the fearful depth of the ruts into which it has worked itself, which are the grand obstacles to any thing like systematic, and successful, and speedy public improvements, under the direction of the authorities of the United Kingdom.

If we find the case to be such as we have stated, in a single and definite work which there was but *one way* of doing, we can have no hope whatever upon the grand scale. The primary cause is obviously the same which has "destroyed the people" in all ages—"lack of knowledge" on the part of them whose duty and province it is to possess it the most. We do not say that the matter would be mended by the appointment of a Board of Commissioners; for there has been already no little experience in that way,—so much indeed that one can hardly think of these "boards," without the association of "deal-ends;" and then, if the *Paranomasiac* spirit can rally a second time, we come to the melancholy, "*Delendo est Carthago*," and mourn that the productive power of the country should be addled, and its wealth allowed to run to pernicious waste, because of this lack of knowledge on the part of those who ought to stimulate and direct the whole.

In turning to Hydraulic Engineering, we find ourselves at a loss at the very outset, in consequence of the imperfection of a work executed at the public expense by men who were eminent enough in their way. We allude to the Ordnance survey of the country, and the map embodying that survey, which has been so long in the course of publication. These should have furnished accurate data for solving the very first problem that arises in the study of Hydraulic Engineering as a general and systematic science. In this, as in all other matters, except poetry and politics, it is best to begin at the beginning;—in this case, to determine as nearly as possible the quantity of disposeable water which, in the average of years, falls from the clouds, the height above the mean level at which it falls, and that at which it may be most conveniently stored up for useful purposes, instead of being a source of mischief as it unquestionably is at present.

If those who had the management of the survey had taken and marked the altitudes generally over the country, we should have been able to make an approximate estimate of the extent of surface lying above any given elevation, and, of course, having its surplus water capable of being stored at that. But as this does not appear

ment with the *Great Western* and *British Queen*, and will be amply furnished with every means of safety combined with comfort. Besides their regular course of post, fifty-seven days, Barbadoes, Grenada, St. Thomas, and Porto Rico, will have the opportunity of replying to European letters, so as to make the course of post between these places and London only forty-three days. At Samana the mails will be removed from steamer to steamer without any stoppage of moment; consequently, they will always be under the protection of the British flag. Every place within the arrangement will have two mails each month.—*Mining Journal.*

Slate Pavement.—Experiments have been made to ascertain the applicability of slate to other uses than the covering of houses. The result has been the discovery that, as a material for paving the floors of warehouses, cellars, wash-houses, barns, &c., where great strength and durability are required, it is far superior to any known material. In the extensive warehouses of the London Docks it has been used on a large scale. The stones forming several of the old floors having become broken and decayed, have been replaced with slate two inches thick; and one wooden floor, which otherwise must have been relaid, has been cased with slate one inch thick, and the whole have been found to answer very completely. The trucks used in removing the heaviest weights are worked with fewer hands. The slabs being sawn, and cemented closely together as they are laid down, unite so perfectly that the molasses, oil, turpentine, or other commodity which is spilt upon the floor, is all saved; and as slate is non-absorbent, is so easily cleaned, and dries so soon, that a floor upon which sugar in a moist condition has been placed, may be ready for the reception of the most delicate goods in a few hours. Wagons or carts, containing four or five tons of goods, pass over truck-ways of two-inch slate without making the slightest impression. In no one instance has it been found that a floor made of sawn slate has given way; in point of durability, therefore, it may be considered superior to every other commodity applied to such uses.

Electro-Magnetic Engine.—This machine works by the positive attractive force of magnetic action, without change of polarity (in which it differs from certain magnetic models that have been exhibited) or magnets attracting masses of soft iron upon the periphery of a wheel. The machine has four electro magnets; upon the wheel, which is two feet in diameter, are seven pieces of iron, or points of attraction, called "armatures." The magnets are charged alternately, and the fluid let off and on—or, in other words, the magnets are charged and discharged. The fluid is let off and on by a "break," similar to the handle to a locomotive engine, and is under complete control. The wheel revolves within the present galvanic battery, which is a small one, 150 times in a minute, but by a more powerful battery can be increased to double the rate. By applying a drop of mercury to the key it is increased nearly 50 per cent. in velocity. A lathe is turned by the wheel at an immense rotatory speed. The engine is capable of being adapted and applied to many purposes; at present it is in its infancy, and its powers are hardly known as to their magnitude, but the most extraordinary results may be anticipated.

The Origin of the Coal Trade.—After the capture of Calais, Philippa, of Hainault, the consort of Edward III., resided chiefly in England. Philippa had in her youth established the woollen manufactures; she now turned her sagacious intellect towards working the coal mines in Tynedale. These mines had been worked with great profit in the reign of Henry III., but the convulsions of the Scottish wars had stopped their progress. Philippa had estates in Tynedale, and she had long resided in its vicinity during Edward's Scottish campaigns. It was an infallible result, that wherever this great queen directed her attention, wealth and national prosperity speedily followed. Well did her actions illustrate her Flemish motto, *Iche wrude muche*, which obsolete words may be rendered, "I labour or toil much." Soon after her return from Calais she obtained a grant, giving permission to her bailiff, Alan de Strothere, to work the mines of Alderneston, which had been worked in the days of King Henry III. and Edward I. From this re-opening of the Tynedale mines by Philippa proceeded our coal trade, which, during the reign of her grandson, Henry IV., enriched the great merchant Whittington and the city of London.

LIST OF PATENTS.

Six months for Enrolment.

To William Crane Wilkins, of Long Acre, lamp manufacturer and Matthew Samuel Kendrick, of the same place, lamp maker, for "certain improvements in lighting and in lamps."—Sealed April 28.

John Inksome, of Ryder Street, St. James's, gentleman, for "improvements in apparatus for consuming gas for the purpose of light," being a communication.—Sealed April 30.

Orlando Jones, of the City Road, accountant, for "improvements in treating or operating on farinaceous matters, to obtain starch and other products and in manufacturing starch."—Sealed April 30.

William Peirce, of James' Place, Hoxton, ironmonger, for "improvement in the construction of locks and keys."—Sealed May 2.

Arthur Wall, of Bermondsey, surgeon, for "a new composition for the prevention of corrosion in metals and for other purposes." — Sealed May 2.

Thomas Gadd Matthews, of Bristol, merchant, and Robert Leonard, of the same place, merchant, for "certain improvements in machinery, or apparatus for sawing, rasping, or dividing dye woods, or tanner's bark."—Sealed May 5.

William Newton, of Chancery Lane, patent agent, for "an improved apparatus and process for producing sculptured forms, figures, or devices, in marble and other hard substances," being a communication. — Sealed May 5.

George Mackay, of Mark-lane, ship-broker, for "certain improvements in rotatory engines," being a communication.—Sealed May 5.

William Beetson, of Brick-lane, Old-street, brass-founder, for "improvements in stuffing boxes applicable to water-closets, pumps, and cocks."—Sealed May 5.

Frank Hills, of Deptford, manufacturing chemist, for "certain improvements in the construction of steam-boilers and engines, and of locomotive carriages."—Sealed May 5.

Bernard Aubé, of Coleman-street buildings, gentleman, for "improvements in the preparation of wool, for the manufacture of woollen and other stuffs."—Sealed May 7.

Thomas Walker, of Gabashiels, Selkirk, mechanic, for "improvements in apparatus applicable to feeding machinery employed in carding, scribbling, or teazing fibrous materials."—Sealed May 7.

Henry Holland, of Darwin-street, Birmingham, umbrella furniture maker, for "improvements in the manufacture of umbrellas and parasols."—Sealed May 7.

Henry Montague Grover, of Boveney, Buckingham, clerk, for "an improved method of retarding and stopping railway trains."—Sealed May 7.

Miles Berry, of Chancery-lane, patent agent, for "certain improvements in treating, refining, and purifying oils," being a communication.—Sealed May 9.

Auguste Morisan, of Philpott terrace, Edgeware-road, clockmaker, for "certain improvements in the construction of timekeepers."—Sealed May 9.

Rice Harris, of Birmingham, gentleman, for "certain improvements in cylinders, plates, and blocks, used in printing and embossing."—Sealed May 12.

George John Newberry, of Cripplegate-buildings, manufacturer, for "certain improvements in rendering silk, cotton, woollen, linen, and other fabrics waterproof." — Sealed May 12.

Henry Dircks, of Liverpool, engineer, for "certain improvements in the construction of locomotive steam engines, and in wheels to be used on rail and other ways, parts of which improvements are applicable to steam engines generally." — Sealed May 12.

John Davidson, of Leith Walk, Edinburgh, for "an improvement in the method of preserving salt." — Sealed May 12.

Peter Bradshaw, of Dean, near Rimbolton, Bedford, gentleman, for "improvements in dibbling corn and seeds."—Sealed May 12.

James Walton, of Sowerby Bridge, Halifax, cloth-dresser, for "improvements in the manufacture of beds, mattrasses, pillows, cushions, pads, and other articles of a similar nature, and in materials for packing."—Sealed May 12.

Richard Foote, of Faversham, watchmaker, for "improvements in alarums."—Sealed May 12.

John Joseph Mechi, of Leadenhall-street, cutler, for "an improved method of lighting buildings."—Sealed May 12—two months for enrolment.

Bryan T. Anson Bromwich, of Clifton on Teme, Worcester, gentleman, for "improvements in stirrup-irons."—Sealed May 13.

Henry Ernest, of Gordon-street, gentleman, for "certain improvements in the manufacture of machines usually called beer-engines."—Sealed May 12.

William Hannus Taylor, of Norfolk-street, Strand, esquire, for "certain improvements in the mode of forming or manufacturing staves, shingles, and laths, and the machinery used for that purpose."—Sealed May 20.

William Bush, of Camberwell, merchant, for "improvements in fire-arms, and in cartridges," being a communication.—Sealed May 22

James Buchanan, of Glasgow, merchant, for "certain improvements in the machinery applicable to the preparing, twisting, and spinning of hemp, flax, and other fibrous substances, and certain improvements in the mode of applying tar, or other preservative, to rope and other yarns." —Sealed May 20.

James Gallard Davies, of College-place, Camden-town, jeweller, for "an improved clock or timepiece."—Sealed May 23.

THE SURVEYOR, ENGINEER, AND ARCHITECT;

OR

LONDON MONTHLY JOURNAL OF THE PHYSICAL AND PRACTICAL SCIENCES

IN ALL THEIR DEPARTMENTS.

BY A COMMITTEE OF PRACTICAL SURVEYORS, ENGINEERS, AND ARCHITECTS, OF MUCH EXPERIENCE AND IN ACTIVE EMPLOYMENT.

ROBERT MUDIE, LITERARY CONDUCTOR.

HYDRAULIC ENGINEERING.

THIS department of the profession has, to some extent or other, occupied the attention of Engineers from the very dawn of their existence, and must have attracted the notice of rude men before they began to generalize facts, and ground the arts upon scientific bases. But, notwithstanding this, very many parts of it are still obscure, and have not received that attention which their importance deserves; for water, in whatever situation or under whatever circumstances it exists, is a highly interesting liquid, as well in the arts as in the general economy of nature. Besides its fertilizing properties, its buoyancy, its diminution of the weight of floating substances, to the exact amount of the volumes of water which they displace, the perfect mobility of its parts among each other without any positive friction, and the consequent ease with which it can be made a means of transit,—besides all these, and also its physiological uses in the economy of nature, it contains in itself the power of great steadiness and regularity, and which, if duly studied and directed, would add greatly to the accommodations of man, and his sovereignty over material nature.

As the subject of Engineering, the management of water may be conveniently divided into three principal branches: First, Fluviatile, or that which relates to flowing streams, and the improvement of their courses, seasonally or otherwise; Secondly, Littoral, or that which relates to the shores of the ocean, in the formation of harbours, the preservation and recovery of lands, and numerous other matters; and, Thirdly, Pelagic, or that which relates to the oceans and seas, and the formation and equipment of the different species of craft, by which these can be best, most easily, and most safely and expeditiously, made the pathway of nations to all parts of the globe.

In a country like Britain, which is girdled by the ocean on all sides, which abounds in streams and in uplands, upon many of the latter of which, though the seasonal rain falls copiously, much of it falls only to scourge the hills, scour the valleys, inundate the plains, spoil the navigation of the estuaries, and turn the lowlands on their shores into fens and marshes, a thorough knowledge of the principles, and skilful and diligent application of the practice of Hydraulic Engineering is a matter of the very first national importance, and one which should claim the attention of the government and the legislature, and not of them only, but of every man who has the capacity or the means of benefiting his country, in the best and most effectual way in which it can be benefited.

In many of the individual sections of this important branch of engineering a good deal has been done; but it has been done locally and by individuals or companies, or other small septs of men for their own profit in it as a job, rather than upon any public principle. Owing to some cause or other, public improvement, upon any thing like a grand systematic scale, appears to be adverse to the spirit of the British legislature and government. We say "legislature and government," because, in this case, the government is just what the legislature is pleased to will that it shall be. From the experience which we have, it is perhaps as well that the British government lets alone great public improvements; because most operations of this kind which have been done solely under the direction of government, and paid for out of the public revenue, have been very expensive in doing, and very imperfect after they were done. Generally speaking, those works have been in some way connected with the army or the navy; and as glory, not gain, is the expected return of these establishments, even to the most money-loving of nations, it is naturally to be supposed that works, whether land or marine, which are constructed on their account, should follow the general law. Government works for the general accommodation and benefit of the country have been exceedingly few, and it would probably have been as well if these few had never existed. The Caledonian Canal is one of the longest and largest of the Parliamentary works; and although we believe no objection can be taken to the line of this canal, yet the execution of it is very imperfect; and, were it not that there is a supply of water *ad libitum*, the banks and even the bottom of this canal are so leaky, that there would be a deficiency of water in summer, independently altogether of the working of the locks—and the same in winter indeed, were it not for the frost, which however seals the canal against all transit, at the same time that it stops the fissures. It is true that there was much to contend against in the nature of the soil, which consists of the debris of the adjoining mountains, and is in some places so exceedingly porous that underground winds blow freely and pretty strongly through it, and, when the cutting was first made, the arm could be thrust horizontally into it up to the shoulder, without meeting with much resistance. We do not mean to say that those to whom the execution of this extensive and laborious work was delegated are at all blameable for this; certainly, however, a thorough knowledge of every other circumstance bearing upon the making of the canal, and the utility of it after it was made, ought to have been obtained before the sanction of the legislature had been given, and the public money expended in virtue of that sanction, and therefore "according to law," and consequently not reversible without putting in motion the whole legislative machine, some of the wheels of which are understood to be so deep in the rut of ages, and remaining so doggedly there, that there is no means of starting them but by golden levers. Indeed it is the cumbrous and unwieldy structure of this machine, its terrible inertia, and the fearful depth of the ruts into which it has worked itself, which are the grand obstacles to any thing like systematic, and successful, and speedy public improvements, under the direction of the authorities of the United Kingdom.

If we find the case to be such as we have stated, in a single and definite work which there was but *one way* of doing, we can have no hope whatever upon the grand scale. The primary cause is obviously the same which has "destroyed the people" in all ages—"lack of knowledge" on the part of them whose duty and province it is to possess it the most. We do not say that the matter would be mended by the appointment of a Board of Commissioners; for there has been already no little experience in that way,—so much indeed that one can hardly think of these "boards," without the association of "deal-ends;" and then, if the *Paranomasiac* spirit can rally a second time, we come to the melancholy, "*Delendo est Carthago*," and mourn that the productive power of the country should be addled, and its wealth allowed to run to pernicious waste, because of this lack of knowledge on the part of those who ought to stimulate and direct the whole.

In turning to Hydraulic Engineering, we find ourselves at a loss at the very outset, in consequence of the imperfection of a work executed at the public expense by men who were eminent enough in their way. We allude to the Ordnance survey of the country, and the map embodying that survey, which has been so long in the course of publication. These should have furnished accurate data for solving the very first problem that arises in the study of Hydraulic Engineering as a general and systematic science. In this, as in all other matters, except poetry and politics, it is best to begin at the beginning;—in this case, to determine as nearly as possible the quantity of disposeable water which, in the average of years, falls from the clouds, the height above the mean level at which it falls, and that at which it may be most conveniently stored up for useful purposes, instead of being a source of mischief as it unquestionably is at present.

If those who had the management of the survey had taken and marked the altitudes generally over the country, we should have been able to make an approximate estimate of the extent of surface lying above any given elevation, and, of course, having its surplus water capable of being stored at that. But as this does not appear

to have been thought of we must proceed by a sort of guess work; and in doing this we shall take an assumed data, under and not over the truth.

Suppose, then, that rather less than one-sixth, that is 6,000,000 acres, of England and Wales, leaving the sister kingdoms out of the question, is above a mean level of 400 feet, we are to inquire what is the annual quantity of disposable water which falls upon this, and contains in itself a power equal to its average fall from this height, capable of being applied at any number of places along the descent.

The average annual depth of rain which falls in England has been variously estimated, and probably in some instances too high; but it may with safety be taken at 30 inches; and, as much more falls on the hills than on the plains and valleys, we may also safely say that, after making every allowance for absorption by the earth, and evaporation, a foot in depth of disposable water falls annually over all the 6,000,000 of upland acres. An acre is 43,560 feet: therefore the whole disposable water which falls annually upon the uplands must be 261,360,000,000,—say 260 thousand millions of cubic feet. The weight of this is 16,250,000,000,000, say 16 billions of pounds avoirdupois, or, in round numbers, upwards of seven thousand millions of tons; and annually this enormous weight descends through an average height of 400 feet. Allow three of the seven for friction of all kinds on the descent, which is an ample allowance, and there remains 4,000,000,000 tons descending 400 feet as an absolute power. An ordinary horse power is equivalent to the raising of about 32,000 lbs. one foot in a minute. Therefore, the power of the surplus water is equal to that of 500 millions of horses, acting for forty minutes. Say that it is extended over 300 days of the year, and in use 8 hours each day; and we have a constant power of more than *a million of horses*, in the simple fact of the descent of their surplus water from the heights; and this is fully equal to two-thirds of all the horses in the kingdom, for whatever purposes they may be used;—and this, too, without any expense of maintenance to the power, and only a little skilful engineering in the application of it. If we take all the descents below 400 feet, and add the surplus water which falls upon them to that which comes from the uplands, we shall, independently of the estuarial flats—and the tide might, generally speaking, be made available upon them, have to at least quintuple our number of horse power, or make it *five millions*,—an establishment of horses which would cost more than £100,000,000 yearly, independently of harness and other appointments, implements, and machines; and these would cost more than the whole application of the power of the surplus water.

Such is the vast power which England possesses in that surplus of rain water which, by being neglected, is now a minister of evil, and of evil only. We do not say that the whole of this will ever be made available as a motive power; but there is, in water duly applied, a stimulating power upon vegetation, and an equalizing influence upon the seasons, which may be turned to more beneficial purposes than its mere weight as water, great as that is.

But we must not estimate the anticipated application of the future, by any thing already accomplished. When man first kindled a fire by rubbing one stick against another, moulded a clay pipkin with his fingers, and obtained boiling water, he had no idea of the steam engine: and the first contriver of that engine would, in all probability, have been a perfect infidel, if what it now accomplishes every day had but been named to him, as a prophecy having some chance of fulfilment.

The rock upon which we are all in danger of splitting, and none of us more so than those men of success and name, who are so influential among, or rather over, the juveniles, is, that we all fancy ourselves to be so wondrously wise that we doubt whether any future generation can equal us, and quite sure that we can never be surpassed. If this were confined to the empty and vain among professional men, it would be argument only for derision; but unfortunately it is not only very prevalent among the men of authority, but is one of the chief means whereby they obtain that distinction. Now, in as far as science and those arts which are grounded upon science are concerned, authorities are loathsome idols, and those who admire and worship them mean and spiritless idolaters. In all cases where nature furnishes a specific model, as in the sculpture of the human figure, the man who comes nearest to this model has some title to be worshipped; but in science, the case is quite the reverse, and the men who have been the most eminently useful have invariably set at naught the idols of authority, and struck out new courses for themselves. But let us return verbally to our main subject: in fact and spirit, this can hardly be thought a digression.

Great as would be the power obtainable from this surplus of rain water, if it was collected in suitable reservoirs and thence given out according to the necessities of the season, its powers of mischief, in its present unrestrained state are much, indeed almost immeasurably, greater. The time which it takes to descend to the confluence with the sea, or with the dam formed by the resistance of the tidal water, is reduced to less than a fourth of what it would be according to our calculation, and consequently the mere weight during the time is multiplied by four. This however is not all or nearly all, for there is an increase of velocity; and though, from the surface being extended, this is not so great as the increase of the mass and weight, it is considerable, and in the average of streams may be between two and three times as great as the ordinary flow. Calling it three times, and applying the common theory, that the effect is as the mass and square of the velocity jointly, the destructive effect of the streams, occasionally swollen by the surplus rains, will be 36 times that of the uniform descent of the same quantity of water down the same slope. This shows us why the floods of comparatively small streams are often so very destructive; and also why the channels and estuaries of rivers of more ample dimensions are so uncertain and dangerous in their navigations on account of freshly-accumulated, or shifting, banks.

This subject of reservoirs, in which the surplus water could be preserved, and let out as wanted, is but one small section of fluviatile engineering; and of it we can mention only the general principle and utility in an article like the present,—inasmuch as the practice of every individual case must be worked out on its own data. Advantageous as it would be, it is also an improvement which could not be carried into execution without much preparatory discussion; because most streams of any considerable length, of course, pass over the grounds of many proprietors, and it would be difficult to make them agree, and still more difficult to make them comprehend the utility of such a project.

The disposal of the water conserved in the manner at which we have hinted forms a second section of this branch of Hydraulic Engineering; and the way in which this is to be done, whether for giving motion to machinery, for irrigating the land, or for any other purpose, must also depend upon the circumstances of the individual case,—such as the character of the surface, the nature of the strata, and the occupation of the inhabitants. But, whatever these may be, the command of an abundant supply of water all the year round is equally advantageous in them all; for the two properties of power to move machinery, and fertilizing influence upon the productions of the earth, suit the opposite extremes of manufacturing and agricultural districts, and of course all the intermediate shades of mixed occupation are included between them. The mere cleaning and straightening of the water-courses would in itself be a very great improvement; for we have known instances in which the mere substitution of a straight drain for the naturally serpentine bed of a stream has brought many acres of what once was quagmire under the plough as fertile and valuable land. The rationale of this is easily explained: When a stream flows sluggishly and in a very winding channel, the silt which it deposits closes up the pores of the banks and prevents the under drainage. In consequence of this, when the stream floods the banks, or even when the rain falls upon them, it sinks into the soil, remains there, destroys the roots of the wholesome herbage, and brings on an unkindly vegetation of some aquatic plants and mosses. This may be seen in the valley of any stream which in some places ripples along with a brisk current, and in others crawls dull and sluggish; and it is not confined to places where, as one would say, there is a predisposition to the formation of moss, for it is just as apparent in the streams of the chalk districts as in any others. Indeed, whatever the nature of the soil may be, we invariably find kindly herbage upon the banks, where the stream runs with a current; and we as invariably find coarse aquatic plants and mosses where it is dull and stagnant. The grand cause of this is the deposit of the finer particles of the soil, which render the banks and bottom of the channel waterproof; and, thus, every flood of the stream and every fall of rain converts the adjoining grounds more and more into quagmires. This deleterious effect is not confined to the immediate banks; for the springs, which should find their out-

lets in the channel of the stream, being sealed up there, get gorged with water, and have to find outlets for themselves higher up: these they find on the margin of the quagmire; and, as the water which they discharge stagnates, the bog keeps constantly extending, the part proximate to the water-course being quagmire, and the distant part a puddle,—especially during the rains. The quantity of land which is destroyed by this neglect of the water-courses is very great, and the destruction is far more serious than those who have not studied the subject with attention would be apt to suppose. It is not only unfit for the plough, but the rank vegetation which it produces is disliked by every domesticated animal. The surface will not bear cattle; and, if sheep are put upon it, they are affected with rot, both in the foot and the liver. Not only this, but at certain seasons of the year—the spring and the autumn especially, those quagmires, which are always cold, spread withering winds over the neighbouring districts; and, in passing along the course of a stream, we have often seen the potatoes, the red clover, and other plants, blackened wherever there was a neglected channel and its consequent quagmire, while where the channel was clean, and the water had a current, not a vegetable was touched. The effect upon animals is equally pernicious; for the cattle in the neighbourhood of those quagmires are sickly, and the people are subject to ague.

These considerations of themselves, and without reference to the direct uses to which the water can be applied, ought to be sufficient for drawing attention to the subject. We can, however, enter into no details as to what should be done in any one instance, because each case has its own peculiarities, and must be treated in accordance with them.

It is doubtful whether the present state of the law of property in Britain would or could be made to admit of that economy of rain and streams of water, which would so much promote the advantage of all. As the law stands, unless there is some specialty in the individual case, each proprietor has absolute property and control of that portion of the stream or river, which flows across his own land; and the lower proprietor must receive it from the upper in whatever condition and quantity he chooses to deliver it. It may be delivered in a single channel or in many, and it may come pure and sparkling, or foul with the sporæ of mosses, and all other impurities; and, if the river is large enough for being navigable, unless the navigation is protected by immemorial custom or direct statute, any one proprietor may stop it on his grounds, either by his voluntary act, or by neglecting the channel.

But, supposing the surplus water to be duly conserved in reservoirs, and all the water-courses brought down to the tideway in the best and most effectual manner, a very important part remains still to be done, and it is one which is perhaps attended with more difficulty than any or all of the more inland operations. This is the management of the "outfall," so as to obtain the clearest and most direct communication with the sea,—the one which shall produce the greatest flow and ebb of the sea, carry the tide farthest up the channel, and, by working itself clear, be the most permanent. At page 32, when noticing the plan for rendering the river Nene navigable to Peterborough, we offered a few casual remarks on this subject. These were few, however, and applicable to a peculiar locality; and the full investigation of the case requires the consideration of many elements. Of these there is one—the sea, which is all too mighty for human control, and which, therefore, except within very narrow limits, must be left to follow its own; for, if the sea is cutting away the land in any place, no embankment, or other work of human art, can stay its progress.

This is especially the case where the main set of the tide-wave is along shore, and the shoreward part of it is retarded by projections of the land, or accelerated by the indraught of bays or estuaries. Now along all the shores of the British Islands, this is the general set of the tide in the offing, though it is variously modified in different places, in consequence of the irregularities of the line of coast, and partially also by the alternations of deep water with shallows and banks. The only point at which the main tide would broach right in-shore, in Britain, is at Land's End, and there it is broken by the Scilly Isles, and the rocks and shoals belonging to that group. This is the only main point of divergence of the British tides; and the points of confluence are near the straits of Port Patrick and of Dover. The former causes strong and peculiar tides to set into the Bay of Morecombe, and the Solway Frith and its bays and creeks. The latter occasions no peculiar rise of tide, because the Channel tide follows the continental shore, and is ultimately extinguished on the coast of Jutland, while the North Sea tide, which sets in the opposite direction, is extinguished on the coast of Kent, more or less southward, according to the state of the weather. Partly by the indraught of the Wash and the estuary of the Thames, and partly by the pressure of the opposite tide between it and the continental shore, which causes a permanent ridge in the slack water between them, this North Sea tide presses heavily upon the coasts of Norfolk and Suffolk, and also upon the north-east of Kent; and, as the soil which is disintegrated here is not carried off by any current, it goes to augment the banks which are so numerous in the lower estuary and offing of the Thames. The operations of the sea upon those coasts, and in this estuary and offing, are far too powerful for being in any way controlled by man; and so they must be left to their fate; but still there are eddies in some of the creeks and outfalls of the small rivers, and these might be improved, by the acquisition of new land and better navigations for the local craft.

The Channel tide, being the only one which sets directly from one of the great oceans, is the most powerful tide that sets along any of the shores, though the tide which is extinguished in the Bristol Channel, being wholly interrupted by the funnel shaped lines of coast, which close in at the confluence of the Severn, rises to a far greater height. The Channel tide is however the only one which occasions a drift of shingle along the whole line of the coast, independently altogether of the debris that is carried down by the local rivers; and, in spite of whatever might be done in the way of improving these, and the creeks and natural harbours, the drift would continue to force shifting bars across all the inlets on the south-east coast. Important as the subject is, however, and much as it should attract the attention, and amply as it would reward the labours, of engineers, we must take leave of it for the present.

ARCHITECTURE, AND FRESCO-PAINTING, AT MUNICH.

The name of Munich—now tolerably familiar to almost every one, carries far different ideas with it now, to what it did some twenty years ago. Though itself a place of some antiquity, its fame is comparatively of yesterday, and every day seems to add something to its freshness and lustre. This unusual species of transformation, which can be likened only to that we sometimes meet with in fairy tales, by which a decrepit crone is metamorphosed into a blooming maiden, has rendered the capital of Bavaria a new city; not indeed in maps and guide books, but in appearance—in the numerous magnificent structures that now adorn it,—rendering it a second Florence—a rendezvous of all the arts. If we ask where modern architecture has produced some of its most splendid creations?—the answer is, Munich:—if, where fresco-painting has suddenly raised itself out of its long deathlike lethargy, and displayed itself with almost startling pomp and prodigality?—the answer is Munich;—if it be asked where glass-painting has been restored to the splendour of its palmiest time?—where the polychromy of the ancients has been allowed to make its first efforts in modern days?—where Grecian pediments are filled, not merely with figures in relief, but with complete statues emulative of the works of Grecian chisels?—where palaces resemble galleries of art, and where galleries of painting and sculpture rival or eclipse palaces?—the answer still is, at Munich—Munich.

Such being the case, it might have been imagined that ere this we should have been surfeited with descriptions and criticisms relative to Munich, its buildings, and stores of art:—that one traveller would have told us how he was entranced by the gorgeous array of painted windows in the new gothic church of St. Maria Hilf; another expatiated rapturously upon the pomp of fresco and gilding in the Allerheiligen Capelle; a third made a discovery that the architectural masses possess an imposing grandiosity of aspect, in comparison with which the "magnificence" of our own Regent Street has but a very Brummagem look. Nevertheless, with the exception of Mrs. Jameson—and when she was at Munich, much that has since been completed was scarcely then begun,—hardly one of our tourists in Germany have bestowed any notice on Munich. Surprising as this may at first appear, it becomes less so when we consider what kind of reading it generally is that is now served up

to the public under the name of tours and travels, and what the public expect from such ad captandum titles as, "Sketches" here, "Wanderings" there, "Summers," "Autumns," "Notes," "Reminiscenses," *et cætera, et cætera.*

Munich would prove a very dangerous subject for such writers, and a particularly dull one to their readers. A very different kind of talent from that which can concoct a lively gossipping harum-scarum book, crammed with anecdotes sentimental or piquant,—with the scandal of fashionable circles, or the high and mighty doings at fashionable dinner parties, together with a full inventory of the charms of the "gorgeous" Lady So-and-so, or the lovely Madame la Duchesse ——, is required by him who should attempt to give a just and satisfactory portraiture of the modern "German Athens," its abundant treasures of art included.

Yet what is it that has prevented our tourists who sketch with the pencil, and not the pen, from paying a professional visit to Munich? Distance it cannot be, because Roberts has been—and to very good purpose it seems, to Egypt, while others have ransacked Syria and Turkey for subjects. We really do not know how to account for Munich's having been hitherto overlooked; except it be, that beautiful and varied as is the architectural scenery it would supply, it is considered not of a sort adapted to the popular taste here, not sufficiently odd and grotesque on the one hand, nor nice and "pretty" enough on the other. Or is it, because our artists themselves have not yet got scent of it?—know nothing of Munich but what they may have read in some old book of travels, or gazetteer?

As for ourselves we are not going to perform the office of cicerone, and describe the buildings seriatim,—more especially as a very good architectural account of all the modern ones may now be found in the Penny Cyclopædia, accompanied with a synoptical table of them and their respective dates and architects' names. Our present purpose extends no farther than making a few comments, chiefly suggested by an article in a German publication, entitled "Munich in 1839." "He who has not seen Munich for the last five years," says the writer, "has seen nothing of Munich at all;" which looks not only very much like a compliment, but a pretty strong one too. And yet, strange to say, the continually progressing architectural splendour of the city is made ground of complaint, for the reason that many structures which a short time ago were deemed almost miracles of art are now deposed from their supremacy, being thrown quite into the shade by later ones, which in turn may shortly be compelled to resign the palm to newer and brighter rivals. Whether such complaint be made in perfect sincerity, we know not, but it is certainly one in which we are far from sympathizing; or rather we should be exceedingly glad were cause for it to be transferred from Munich to London. "What is it to end in," exclaims the German, "if we are to go on thus, building more and more sumptuously, more and more extravagantly?" One probability, we reply is, that something more noble and dignified than what has hitherto been achieved, will be produced. But we need not attempt to combat an opinion which is not likely to make converts; and therefore pass on to something more intelligible and satisfactory, namely, the writer's observations on the church of St. Maria Hilf in the Au *Vorstadt* or Suburb, which was consecrated last year a few months after the decease of its architect, Daniel Joseph Ohlmüller.

"If we may judge from what he has here created, Ohlmüller was capable of achieving truly great things; for in this edifice, which will remain as the monument of his genius, he has given us a piece of architecture of intrinsic beauty and worth. It is indeed but a Gothic church, neither whose proportions nor whose decorations can be said to be of his invention, as we find in it nothing more than what is to be met with in a thousand structures of the same class, erected in the middle ages; yet had some great master-mind planned our new Munich in the same spirit, creating fresh elements out of the stores and traditions of ancient architecture, in like manner as Ohlmüller has composed his edifice out of the forms and ideas belonging to Gothic art,—then indeed, it would have become another Athens. After all that we had heard as to the purity of the details, and the striking impression produced by the interior on first entering it, we felt quite taken by surprise. Such airy lightness in its loftiness!—such captivating proportions!—the whole looks as if hewn out of solid alabaster! And then, what richness of ornament! which after all does not appear so much to be ornament as natural buds, foliage and flowers springing forth from the slender-stemmed pillars, and from the interlacing arches of the vaulted roof. The whole character of the Gothic style during the middle ages seems to be expressed in this single church: not that it professes to give us a compendium of the entire style, but because all that we here behold emanates from its principles, and conducts us back to them. Every thing is in its proper and natural place: every part is intimately connected with, dictates, and serves to explain, the form of some other: there is nothing but what has some reference to the whole,—nothing indistinct or arbitrary. There is no one church, erected in the middle ages, which actually comprehends, as this has in a manner been made to do, all the aims and ideas that reveal themselves in the edifices of the olden architects; nor is there one that makes an impression at once so sublime, and so full of animated cheerfulness. Nothing of trivial ornament, either on the walls, the pillars, or the roof, is allowed to weaken such impression. The whole appears to be a noble idea breathed from the mind at once, and then instantly fixed,—crystallized, as it were, into eternal solidity. It is, indeed, a pity that the ornamental wood carving of the middle ages was not also revived, in order to decorate the pulpit and its baldachin, and also the stairs leading up to it. Or if such decoration was not to be thought of, at least plain unpainted oak would have been greatly preferable to the present highly varnished and lacquered work, which has a rather parti-coloured effect. And yet why should I object to it on that account, when it is the parti-coloured windows themselves that produce such a wonderfully noble and rich character? A splendour and depth of colouring has been here attained, which even the far-famed windows of the Lorenz-Kirche (Munich) fall short of;—the most brilliant crimsons, the most lustrous greens, besides innumerable shades of tint, here display themselves, while the general effect is most captivating!"

For one who seems disposed to find fault wherever he can, the above must be allowed to be rather lavish praise. However, our fastidious critic does not let this building escape quite scot-free from censure, as he afterwards strongly protests against the situation chosen for it, which is quite in the outskirts of the city, in the midst of a neighbourhood of mean houses, and where it cannot be approached at all by a carriage. But let us hope,—especially as the site itself is an open one, that this defect will in time be remedied, and that this church will serve as a nucleus for other architectural improvements in that quarter. Another and far more serious objection is it that the exterior of the church is not entirely of stone, but of brick, with stone only for the ornamental parts,—a mixture of material wholly incompatible with beauty or dignity in ecclesiastical architecture.

We had begun to hope that the writer was beginning to look at things in a more favourable aspect, when, lo! in his second article he breaks out into a most lugubrious strain of dismal forebodings of all kinds—horrible impossibilities not to be realized—if ever—for some time to come:—in short, he is quite an adept in the art of being miserable. Not only does he predict a satiety and disgust of art attendant upon repletion with it, but outbursts of popular vandalism and destruction; or, should the edifices of Munich escape such devastation, they must yet yield to that more slow but more implacable and relentless of all destroyers and iconoclasts—Time! Why truly we ourselves do not imagine that a miracle will be wrought in their favour, yet if we are to groan and weep at prospects of that kind, our eyes would never be dry. We are not disciples of that Heraclitus philosophy which dresses itself up in a suit of sable, cries *memento mori* upon every occasion, and assures a bride adorned in her nuptial attire that she will one day make a very different figure when wrapped in her shroud. Were such philosophy to get the upper hand of common sense, all enterprise would be paralyzed; and architecture would be called upon to build us nothing save cemeteries and tombs. Babylon, Nineveh, Palmyra, are no more, yet if that fact legitimately furnishes the argument here strained out of it, it proves that neither London nor St. Petersburg ought ever to have been erected.

We turn aside, however, from the writer's hypochondriacal reflections, to give his observations upon the state of fresco-painting at Munich.

"As was to be anticipated, fresco-painting has here made extraordinary progress. At first it was necessary to learn experimentally the effect of the atmosphere and weather; and much that had been executed was obliged to be either repaired, or else expunged and painted quite over again; but all difficulties of that sort are now overcome. It is, besides, now perceived that this kind of painting is

suitable only for works upon a large scale. To what purpose, in fact, should such neck-breaking exertion both for artists and spectators be resorted to, in order to produce diminutive subjects upon a frieze, or decorate the panels of a ceiling? Five years ago, people used to mount ladders and walk upon scaffolds, to contemplate with ecstatic admiration the paintings, both unfinished and finished, in the apartments of the Neue Residenz. Nothing could be more truly delightful than the idea that a king should adorn his own private rooms with subjects from the works of classical poets; while the execution of them was allowed to be no less satisfactory. But now that we behold the gigantic frescos of the Habsburgh-hall and Hohenstaufen-hall, in the Residenz, and those in the new Ludwigskirche, the earlier ones strike strangers as the engravings of annuals and keepsakes would do by the side of large oil pictures. People have had their bellyful of the good things of art, till they are beginning to be cloyed, and have little relish now for puzzling themselves in attempting to make out and comprehend the intricate minutiæ of delicate arabesque. Still more tedious and painful is the labour of examining the skill of the pencil which may be said to have been thrown away upon the series of domes of the corridor or side gallery of the Pinacotheca. With powerful conception have Cornelius and his associates there begun a complete cyclus of the history of art: admirable in execution, delicate yet energetic, the whole is a fine graphic poem, yet who will be at the trouble of perusing it where it now is,—of studying those lofty domes peopled with diminutive figures? Merely to look up at them is neck-breaking work, and a good hour's work into the bargain. It will be impossible fully to enjoy these admirable compositions, until they are translated into engravings.

"At present the interior of the Ludwigskirche offers to the eye a mere chaos, a confused mass of scaffoldings piled up one above the other, so that we can merely guess at what will be the general effect of the church, and hardly that; on which account it is still doubtful what its architectural character will ultimately prove. But here is a work of fresco-painting, a truly noble performance of the kind—an altar-piece of most impressive effect and dignity—a production that well repays the immense labour bestowed upon it. We here behold a masterly effect in the ensemble, a grandeur in the general composition, and a careful study of all the details, worthy of such a master as Cornelius, and well worthy the immense pains it has cost to render it an enduring monument of art. * * * It is true, those who are unaccustomed to fresco-painting miss here the rich *impasto* tones of oil: hardly can they reconcile themselves to a mode in which the energy of pencil appears to be only indicated, and the colouring to be slight and unfinished. Yet after contemplating for a while this 'Last Judgment' by Cornelius, the effect becomes quite different from what it appeared at first. The pale tints acquire depth and intensity, and as the eye accustoms itself to this new language of the art, it discovers shades and gradations of colours that give animation and spirit to the whole. The picture with the artist at work upon it, would itself make an excellent subject for the pencil:—Cornelius himself in his blouse, and with his palette in hand, sitting and painting that immense surface of wall—a little body of a man, though an artist of very great soul, an attendant plaisterer beside him, trowel in hand, and a group of visitors and amateurs looking on and watching the progress of the work,—these figures and the scaffold for foreground, would form a highly pleasing and striking *tableau de genre*, and such picture would farther serve to explain the difference of effect between oil-painting and fresco-painting. * * * When the scaffolding shall have been cleared away, when the church shall be filled with worshippers, the effect of this performance will be truly prodigious. We may also confidently expect the same with regard to the paintings in the cupolas. It will be worth while straining one's neck in order to contemplate a poetical revelation conducting us from the Creation to the birth of the Saviour, and thence to the Last Judgment. As we now behold them immediately over our heads upon the scaffolds, these paintings are absolutely awful in their grandeur, nor can they fail to be of striking effect when viewed from below, suspended as an outstretched canopy over the assembled spectators. Yet one such a temple is sufficient for an entire age: it affords incontestible proof that we can accomplish what it was the pride of other and much-lauded periods of art to achieve. A second example of the kind would be superfluous."

Here we take leave of our grumbling German, and readily excuse his hypochondriacal remarks and humour for fault-finding, when we perceive that, notwithstanding his predetermination to censure, he cannot avoid praising,—that his curses melt away into blessings—his revilings into encomiums. Happy Munich; where the errors of art are at least glorious,—its greatest absurdities sublime! L.

ON THE MEANS OF BRINGING BACK SALMON TO RIVERS.

Some readers may wonder what connection there is between salmon and engineering; and it must be admitted that no art of the most skilful engineer can make a salmon. But it is by no means unlikely that the skill of the engineer, if properly directed, might effect even something better than this,—might establish a self-manufacture of salmon in a place where scarcely a stray individual is to be found. As food is of more primary importance to mankind than manufacturing, or locomotion, or any thing else, he who can engineer the most abundant and cheapest supply of food, is entitled to the palm as the most valuable engineer. But fish, of the proper species, and in the proper condition, is among the most valuable of all food; and there are few who will deny that the salmon is at once one of the most palatable and nutritious.

Now, there was a time, and that not very long ago, when salmon abounded in all the rivers of Britain, from north to south, without almost any distinction as to the characters of the strata over which the rivers flowed. They resorted to the rivers of the chalk districts of the south, to the Wiltshire Avon, the Test, and the Itchen, in such numbers, that when boys were apprenticed to tradesmen in the towns on these rivers, it was a regular clause in their indentures that they were not to have salmon above a certain number of times in the week, thereby implying that a salmon dinner made a meagre day,—and it is probable that the abundance of fish was one of the reasons why the monastic brethren fed upon fine fat ones when they fasted. But now the most wealthy Ichthyophagi of the same towns cannot get a bit of salmon unless they obtain it from Billingsgate. In the curse of Gowrie, on the Tay in Scotland, farm servants used to make the same stipulation; but salmon is now a holiday tit-bit, even with the most wealthy farmers in that district, unless when the fish are out of season, and it is mischievous to capture, and dangerous to eat them.

They are becoming more and more scarce every year; and the remnant of them has to be followed to more northerly rivers. What is the cause of this? Some say that the climate of the southern parts has become too warm for salmon. This is not true; for, though the more general cultivation of the soil may have made the winter warmer, it has made the summer just as much colder. The evaporation from the succulent plants which are cultivated is much greater, and productive of correspondingly more cold, than that from the more rigid native productions of the soil. Others have said that the drainage of the cultivated soil, especially where it is dressed with lime, is unfavourable to the health of salmon. This again is not true, or, if true, it is true only to a very trifling extent. He were a slovenly farmer indeed, who would allow quick-lime from his fields to get into the rivers, and we are aware of no other state in which lime poisons fish. In proof of this, we may mention that the trout and eels of the chalk rivers are equally remarkable for their abundance, and their superior quality; and that a single furlong of peat is more injurious to the fish than any length of course over chalk or lime-stone. We grant that the water of mines is pernicious, but that is owing to metallic salts, and cultivation does not tend to increase them. Cultivation increases the food of aquatic animals as well as of land ones; and thus, in every light in which it can be viewed, it should, it must, be favourable for salmon. It is doubtful whether the sewerage of cities is so deleterious to fish as has often been thought. The poisonous products of that, and also the refuse of most manufactories, float on the surface, and speedily pass off in gases; and as it is not the habit of salmon to be much at the surface, it does them no harm; and, besides, in the case of such contaminated places, the salmon are merely passers by, and not residents.

The circumstances which have been enumerated are the chief ones to which the disappearance of salmon from so many of our rivers has been attributed; and they are one and all erroneous, and prove that the parties by whom they are advanced really know nothing about the matter. But there is still another, which is, if possible, more absurd than any of them:—It is said that "salmon are capricious, and resort to places, or quit them, no one can tell

why." Now, there is, and there can be, no such thing as caprice in animals of any description. The laws of their instincts are immediate laws of the Creator, and, therefore, they are perfect, and admit of no variation. Hence, the charge of caprice against the salmon, or any other fish or animal, in a state of nature, is a mere subterfuge to hide the ignorance of those by whom it is advanced.

What, then, is the cause why this most valuable fish has deserted so many of those rivers to which it used annually to resort in great numbers, and contribute so much to the subsistence of the people? We shall best answer this question, or, at all events, we shall make the answer to it more plain and palpable, by first considering another question:—what is it that brings salmon to the rivers at all? But, before we enter upon this, there are two or three preliminary points, upon each of which it may be as well to say a few words:—

First, the very great importance of the subject. Every one who has paid even the slightest attention must be aware of the great value of salmon fisheries in those rivers which they still frequent. The great trouble which is taken in sending them to distant markets, and the great demand, notwithstanding the high price, is ample proof of this. But, notwithstanding all the skill and care of the salmon fishers and merchants, salmon which has been packed in ice, and carried even a moderate distance in the fastest steam ship, never has the genuine flavour of salmon fresh from the water. Therefore, since the salmon were confined to a few of the more remote rivers, it is only the people near these that can get salmon in perfection; and the price is much higher than, with the exception of a few of the wealthy, they can afford. But if there were salmon in all the rivers, as there once was, salmon would be good everywhere, and so cheap as to be within the means of the great bulk of the people, as an ordinary article of food. There is also farther in recommendation of this, that the salmon, if got back, would be got back at a sacrifice of nothing except the trifling expense of engineering; for they remain peaceably in the waters, and multiply there to an immense extent, without consuming one particle of the food of any other species.

Secondly, the project, though novel, is so far from being visionary, that the probability of it amounts almost to an absolute certainty. We have already shown that the improved culture of the land, and the operations carried on in the vicinity of rivers, have no necessary tendency to exclude salmon, and that the fish themselves do not, and cannot possibly, abandon any river from caprice. Still there must be something in the estuaries, or lower parts of the rivers, which is against their instinct, and which makes them pass by the river's mouth instead of ascending the stream as they did in times gone by.

Thirdly, engineers are in general little acquainted with subjects of this kind. They confine themselves too exclusively to the properties of mere matter, and are often woefully at fault when they come to the simpler kind of mixed problems, into which the phenomena of matter enter,—as, for instance, an engineer may make a tolerable ditch or mound upon the solid earth, and yet if the very same engineer has to restrain the current of a river, or bank the sea, the chance is that the very first land flood, or spring-tide storm, shall lay his work partially, or even wholly in ruins. If the problem is still more mixed, and animals, especially those obscure matters of investigation, the instincts of animals, have to be taken into consideration, we may say, with truth, that the very foremost of our engineers would be at a loss. An eye for engineering, and an eye for nature, are a pair that very seldom come into juxtaposition in the same head. The only eminent instance of their having done so, which we can call into recollection at the present moment, is James Watt; and the range of his observation and inference was such that it would be no easy matter to say what he did not observe, or what he could not have applied to useful purposes, if it had at all fallen within the lines of his occupation, or bordered upon them however slightly.

This *monoculism*, so to call it, from which our engineering Polyphemi are not more exempt than those of the most pigmy stature, is owing to two causes, the one of which is very creditable to the engineers, and the other less so to parties of other classes. When the engineer gets a work in hand, he is so thoroughly absorbed by it, and the desire of executing it in the very best manner, that he is apt to lose sight even of those injuries to other matters, which the execution of it may occasion. This perfect devotedness to the work in hand is commendable, as far as it goes, because it is the best means of insuring works of a superior order. It is not, however, quite so advantageous to the general interests of the country, as if all collateral matters were taken into consideration in the ratio of their importance. This, however, devolves more upon those who decide upon what works shall be done, than upon the engineers who have the execution; and it has but too frequently happened, that the projectors of engineering works have not only been totally ignorant of the very first principles of engineering, and the relation between one public accommodation and another, but that they have been totally indifferent even as to whether the work itself should, or should not, be of any public utility, provided that they made their gambling profit by setting it a-going, and "taking in" the requisite number of parties as shareholders. We need not adduce individual instances of this, for they will instantly occur to every reader who is at all conversant with the subject of public works, more especially those of recent times, and above all those which have been floated through Parliament on the inflated vesicles of joint-stock companies.

Even Mr. Scott, whose queries will be found in our preceding number, who is a man of far more general observation and reflection than most engineers, and who has had great experience in erecting machinery upon salmon rivers, in such a manner as to obtain the most complete water-power without any annoyance to the salmon, does not begin quite at the beginning in his very pertinent query upon a branch of the subject now under consideration. "First catch your hare," says the sagacious Mrs. Glass, before she gives one hint as to how the said hare is to be cooked; and though the shallow-minded have sometimes affected to ridicule the great sultana of stew-pans for this, yet it is far more to the purpose than all the postulates of Euclid taken together; and therefore we say, "First," not catch your salmon certainly, but "see that they will come to your river before you adapt the upper and intermediate parts of that river to their accommodation." A salmon ranging in the sea can have no knowledge of the nice passage you have made for him ten or twenty miles above the tide-way; and therefore if you address yourself to his instinct at all, it must be at the very lowest part of the river.

One little fact will serve to illustrate both the inattention of engineers to collateral matters, and the means whereby salmon are made to desert rivers. Few, we believe, will dispute the eminence of the late Mr. Telford as an engineer, and we rather think that in his younger days he was no ignoramus in the craft and mystery of catching a salmon. He was engineer on the Caledonian Canal, and all the operations of that work were carried on under his express instructions. The Ness, though not the best salmon river in that part of the country, had its fair share both as to numbers and quality. In executing the canal, the bed of the Ness had to be shifted a little, at a place called Torrie-Na-Fean; and the cutting away of one bank of the river, and throwing the excavated mud and sand of the other side into the channel, kept the river foul for a considerable time, and left shifting banks on all the shallows downward to the sea. The consequence was that the salmon deserted the river, and we believe continued to do so, not only while it was foul, but until all the newly formed banks were mixed with gravel and consolidated.

This brings us back to our question, as to why salmon resort to rivers, and why they have deserted some which were once favourite haunts; and not only this, for it also gives a useful hint as to the means of getting them back again.

Salmon resort to rivers for the purpose of depositing their spawn, in situations where it shall be secure against being flooded away, or covered to too great a depth, and where it shall be sufficiently near the surface for receiving that influence of the atmosphere and the sun, which are necessary for its vivification. They do not of course philosophize upon the matter, by reasoning on the analogy of cause and effect; but they are guided by an instinct which, though unknown to them, and incomprehensible by us, is far more certain and unerring than any result of human philosophy. It may be that the higher temperature of the top of the brackish than of the salt water without, first entices them into the estuary; and when they have got thus far, they appear to try the banks. If these are such as suit their purpose, they continue to ascend, trying as they go along, for no salmon spawns in a tide-way; but, if they find the banks sludgy

and shifting, they tack about, and again put to sea. If they find the river favourable, so far are they from being capricious, that they persevere in overcoming very serious obstructions, and perform journeys of very great length; and, when they have arrived at the proper distance inland, they perform the labour of the season, and then drop down the stream, keeping the middle, and never trying the banks as they do on their ascent.

This statement, short and simple as it is, contains the whole philosophy of the progress of the salmon up the courses of rivers, and the reason why they resort to one river in preference to another; and, to make them resort equally to all rivers, in those latitudes in which they are common, we have only to give all rivers the character which is attractive to them,—and this is a matter which, to a very great extent at least, is within the province of the engineer: the longer that slow-currented rivers have continued to run, and the more carefully that the adjoining lands are cultivated, there will be the greater accumulation of sludgy banks; and these, from the looseness of their materials, will shift more with the varying states of the river than banks of firm gravel, such as those in which salmon deposit their spawn. Hence the sure means of enticing back the salmon is so to manage the outfalls of the rivers as that the banks may be scoured and firm; and we have an instance of this in the new London Bridge; for though the outfall has been only partially scoured by the removal of the old obstruction, yet it has been scoured to some extent, and the result is, the appearance of more salmon above London. Thus the bringing back of salmon to those rivers which they have deserted resolves itself into the question of the general improvement of the outfalls of rivers; and this involves so many other advantages, and advantages of such importance, that it will require to be treated separately as a principal subject. In the meantime, we invite the attention of all interested—and who is not interested? to the remarks contained in this paper.

ARCHITECTURAL DESIGNS, ROYAL ACADEMY.

(SECOND NOTICE.)

SUBSEQUENT visits have certainly not removed our first impression, as to the general inferiority of this year's show of drawings; nevertheless, we have become better satisfied with some that did not so well satisfy us at first, and have been pleased with one or two which we had previously overlooked; but then we have also detected several others that had better have escaped us entirely. Among these last-mentioned, we cannot help referring more especially to No. 931, "A Design for a Gothic Mansion," on account of the very extraordinary circumstance attending it. Hardly, indeed, could we believe our own eyes, on finding it so designated in the catalogue, after recognising it as being identically similar to the subject of Plate XLI., in Nicholson's "Five Orders of Architecture" where it is described to be the principal elevation of the Seat of H. Monteith, Esq., at Carstairs, near the Clyde, designed by W. A. Nicholson. Now it so happened that we had only the very day before been turning over Nicholson's book, and looking at the elevation and ground plan of building, which is as bad in internal arrangement as it is tasteless in external design. Little did we then imagine that any one would care to father such a production, and exhibit it as his own design at a public exhibition,—even putting all risk of detection out of the question. When we first beheld it, and found it passed off under another name, we doubted, if not our own sanity, at least being in our *sober* senses. But no; we were not drunk, having imbibed no stronger potation than a cup or two of chocolate at breakfast, which has certainly not yet been discovered to possess any intoxicating quality. Could we be mistaken?—Again we looked, and we beheld the same little chess-castle-shaped tower, with the same flag-staff and flag upon it, as in Nicholson's print. Whether this extraordinary piece of plagiarism be a direct infraction of that clause in the Notice to Exhibitors, which says, "No works which have already been publicly exhibited,—no copies of any kind, &c.,—can be received," we do not know; for it may be alleged that the drawing is not actually a copy of the print, inasmuch as it shows the building in perspective—though very nearly in front, and, farther, that it is coloured; some trees also are introduced, and the ground before the house is covered with a piece of green baize, in order, we presume, to keep the grass from catching cold. Of the trick thus played upon them, the Academy could of course have had no suspicion; but then what opinion are we to form of their judgment, when we find them admitting such a very paltry design and performance, when other architectural drawings are rejected, probably much better, because it certainly is not likely there should be any at all worse. However, any thing in a frame is, it seems, good enough for the architectural room.

The above remarkable case of delinquency* has detained us somewhat long, but we hope that our exposure of it will operate as a wholesome caution for the future; although, as far as the Academy itself is concerned, we have not the slightest idea that any remarks, proceeding either from ourselves or any one else, will induce it to bestow any attention on this department of its exhibitions. What, we ask, are the Professor of Architecture and his architectural brethren among the R. A.'s about, that they seem to let things take their own course, without any interference from them? We do hope, however, that ere long some in the profession, though not in the Academy, will bestir themselves for the credit of their own art.

In resuming our remarks upon the contents of the architectural room, we must be allowed again to revert to the perspective view of the west front of Mr. Pennethorne's design for the Royal Exchange, as one of those subjects which gain upon us the more we consider them. Of the entire design and plan we cannot now recall to mind enough, to speak positively of its merits and defects as a whole, but, as far as this façade is concerned, we greatly prefer it to any of those with a prostyle portico in that situation, for although it nominally resembles the majority of them in being a Corinthian octastyle, it differs from them all more or less in every other respect, more especially in the richness of its columniation, it being brought so much forward from the rest of the building as to become almost square, being hexastyle on its sides, or having there five open intercolumns, while there are seven in front. It does not, however, form a mere open space within, but contains a *cella*, between whose walls and the external columns a space equal to one intercolumn is left on each side, and that of two intercolumns and a column in front. Hence, while there would be great continuity of character—a far greater display of columns than in any other example we at present possess—and which, to say the truth, consist of little more than a single range of pillars in front,—there would be a very great degree of play and variety, including that produced by light and shade. The walls of the *cella* within the portico are carried up so as to form a lofty square tower, terminating above in a smaller peristyle of the same order as the portico below, and presenting an hexastyle, or five intercolumns, on each side. And, if both a portico and campanile be required, as it seems is the case, we should not hesitate to assign the preference to this design, as far as those two features are concerned, over any yet exhibited. There is infinitely less of the church-steeple character in Mr. Pennethorne's tower than in those adopted by other architects, some of which appeared to be, if not exactly plagiarisms, too direct imitations of Wren's compositions of that kind. Still, notwithstanding its artistical merits, it is not very surprising that this design should have been flung overboard at once as utterly inapplicable, seeing that it made no provision whatever for shops, which are not only a sine qua non with the committee, but the amount of rental from them is likely to preponderate over other considerations. How far Mr. P.'s plan might be judicious and well-arranged in other respects we cannot now say, since all that we recollect of it is, that the Exchange area itself appeared to be considerably more spacious than in most of the other designs. Indeed, for want of accompanying ground plans, it is quite impossible to judge satisfactorily between this and the other designs for the same building here exhibited. The same remark, in fact, holds good as to the architectural drawings generally, because, owing to plans

* If any thing is ever turned out after the exhibition has been opened, we think it should be No. 931, rather than No. 100, against which the "Art-Union" makes a most canting protestation, stigmatising that production of Chalon's as most offensively immodest; whereas the immodesty amounts to nothing more than the full-length display of a woman's leg in a pink silk stocking. Yet no exception is taken by such overnice people to the studied nudities and voluptuousness of Etty and his delicate indelicacies. Or, if expulsion is to be thought of at all, it would not be amiss were Turner's insanities of the present season to be ejected, and transferred to Bethlehem Hospital or St. Luke's, to one or other of which "parishes" they evidently belong, and should be passed home accordingly. That Turner is now stark mad admits not of a doubt, but that is no reason why the Academy should be crazed too,—or at least expose him to the derision of the public.

being virtually prohibited, their merits or defects in that respect are kept quite out of sight; while, in many instances, too, we can guess only very imperfectly at the size and general external appearance and character of the buildings represented. It would seem, however, that this part of the exhibition ought to be accommodated not to the taste of architectural visitors, but to that of the 'οι πολλοι, who do not go to see designs, but picture drawings; and the more flashily coloured they are—the *prettier* they are made look, the more chance do they stand of being noticed. Besides the other designs for the Royal Exchange mentioned in our preceding number, there are one or two more we did not then name; and as the Exchange question will continue to be one of interest and importance for some time to come, or at any rate ought not to be left to go to sleep, we shall say a few words respecting Nos. 978 and 997, two perspective views of that sent in to competition by Messrs. Wigg and Pownall. The first of these shows the exterior which has a Corinthian octastyle, at the west end; and six attached columns of the same order in the centre of the Cornhill front; but neither the portico nor any other part, as far as it can be made out from a single drawing of this kind, shows much originality or superior taste. We are better satisfied with the interior court,—which, after all, will certainly be one of the most prominent parts of the structure, and ought therefore to be rendered as effective in its architecture as possible. The *piazza*, or covered ambulatory, is here formed by an arcade of twenty-eight arches, (viz. nine on each side, and five at each end) supported on massive piers, decorated with a *sub-order* of coupled Ionic pilasters, whose entablature forms the imposts to the arches. Above the arcade there is no second order, but merely a series of bold windows, corresponding with the arches below, and having pediments alternately angular and segmental; and the whole is crowned by a handsome cornicione with a balustrade and vases upon it. Though there is nothing even of novelty in the composition, the whole is in good taste, well proportioned, and in a noble style of Italian architecture; but one of its merits, we suspect, would be likely to be deemed a fault, because the breadth and depth of the piers, which contribute so much to the expression of solidity below, would screen the ambulatories from the open area more than appears to be considered desirable: and yet if the centre area is to be hypæthral or left uncovered, all the more requisite is it that the ambulatories around it should be screened as much as possible from the weather, which substantial piers between the arches would certainly help to do.*

Nos. 973 and 999, the one by J. Goldicut, the other by W. Granville, are also two ideas for the Royal Exchange, now first of all, we believe brought forward. Neither of them recommends itself by any kind of felicity, so as to suggest any material improvement upon what had been previously produced. Mr. G.'s,—merely a small elevation of the West front, consists of no more than an adaptation of the form and style of the Coliseum at Rome, to that part of the building, and consists similarly of three tiers of arcades, and three orders of columns. As far as relates to curving off that extremity of the site, so as thereby to conceal the obliquity of the north and south sides, and unite them to the west one without any awkward angle, something of the semicircle might be advantageous. It strikes us, therefore, as being rather singular that, among all the designs which had porticos, there was not one of the latter forming a semicircle, notwithstanding that such plan would be more novel as well as appropriate withal, and would carry with it less of the usual church portico in its general appearance.†

* Mr. Cockerell seems to flatter himself, that by means of the cove he has given his court, he has succeeded in effecting a satisfactory compromise between a covered and an uncovered area. Yet, not to mention other objections which we could make, it appears to us, that while such cove would exclude the sun from the lower part of the court, it would afford no protection against rain, consequently there is great danger that such a place would have a cheerless appearance, and continue damp for a long while after rain. Having here referred to that singularity in Mr. C.'s design, we may perhaps be allowed to ask how it happened that his design, when first exhibited along with those of the original competitors, passed under another name. Was it because Mr. C. did not then care to take the responsibility of it upon himself? This circumstance certainly requires some little explanation. Neither do we exactly understand why, if the design was his, and he was one of those who entered the first competition, he alone should have been allowed to come forward again with his first ideas altered,—and, we presume, matured and improved, while a second opportunity was withheld from all the rest who were similarly situated.

† There was indeed one design, by Mr. Bunning, if we mistake not, which had some kind of semicircular arrangement of columns at the west end, but we do not now recollect enough of it to be able to say whether the columns formed a portico.

In Mr. Granville's design, shown in a "perspective view, taken from the Mansion House,"—though it certainly did not convey such idea to us—the west front is similar to the south, and therefore, we presume, to the north one; and so far it differs from every other design for the same purpose. It struck us chiefly as being a monotonous, lumpish mass, on which account we did not examine it so attentively as to be able to say more about it.

Having disposed of the designs for the Exchange, not one of which will be carried into execution, we will now turn to some of those which show us buildings either actually in progress, or about to be commenced. No. 914 is the elevation of the Wesleyan Centenary Hall, into which the late City of London Tavern, in Bishopsgate Street, is now converting by Mr. W. T. Pocock, and of which the façade is already carried up as far as the entablature. It consists of an arched basement supporting a lofty Corinthian order, of four columns and two pilasters, all of them fluted, between which are two series of windows. Above the entablature, over the columns, where it forms an advancing break, rises a deep podium, surmounted by a copy of the monument of Lysicrates, but for what particular purpose it is intended we cannot guess. If intended chiefly as an ornamental finish to the building, we think it might very well be dispensed with, both because even as a copy it is now rather stale,—it being already applied as a belfry at St. Philip's chapel, Regent Street; and because the building is even now sufficiently high without any extraneous addition to it. It would have been better could the architect have hit upon some mode of counteracting the narrow proportions of his front, instead of which he has exaggerated that narrowness, more than there was any occasion for doing, by dividing the whole into narrow upright compartments, and squeezing up his windows between large columns. Of ornament there is no lack, but then it is applied with so little taste or judgment that the effect of the whole is the reverse of happy,—partakes even of paltry, vulgar finery; besides which, there is no sort of feeling or keeping as to style. The basement, which at the best, is in a very petty, insignificant manner, is not at all improved by the few horizontal scorings *a la roast pork*, bestowed upon it. There is certainly nothing here to prepare us for the classical monument that is to be clapped upon the top of the whole, and the very proposal of which, we should have imagined, would have filled the Wesleyans with horror, as savouring of heathenism and paganism, and setting up Lysicrates over their founder, John Wesley!

No. 919,—"North elevation of Calby, Kirkcudbrightshire, is now completed entirely in granite,"—J. B. Papworth,—looks gloomy and dismal enough, and is as bare and naked as the preceding subject is overdone with ornament, and with crowded up parts.

No. 921,—"Terminus of the London and Blackwall Railway," is a handsome piece of Italian architecture, by Mr. Tite, and somewhat similar in design to that of the terminus at Southampton, represented in the engraving in our third number. But this Blackwall terminus is not shown to particular advantage. Mr. Cheffins' view of it—for that is the name attached to it in the catalogue, being by no means a particularly attractive drawing.

Nos. 923 and 939 are both by Mr. Barry; the first of them is the elevation of the entrance front of a Unitarian chapel, lately erected at Manchester, which, though a small building in the plain style of early Gothic, is excellent in character, and treated with that taste and artist-like feeling which generally distinguish Mr. Barry's productions. The other subject shows the proposed addition and alterations at Highclere, the seat of the Earl of Carnarvon; according to which the present plain house will be extended and made loftier, by placing square pavilion towers at its angles, and giving greater height to the second floor; besides which, there will be a central tower or additional story, rising from the roof of the building. The exterior will be entirely re-cased, so as to produce along with the new parts, a uniform design of stately architecture in that mode of the Elizabethan style which is characterized by lofty upright windows, forming with the panelled parapet beneath, and the cornice mouldings or chambraules above them, so many continuous compartments through the different stories. At one end of the front, the ground floor elevation is carried on so as to form an architectural screen or lower range of building. The style here adopted leads to other differences from the domestic architecture of the present day, and its arrangements, owing to the importance given to the upper floors, on which, it is to be presumed, many of the sitting rooms as well as chambers will be placed, instead of confining the former, as

is now usually done to the principal floor, whether it be a ground floor or *rez-de-chaussee*, or elevated upon a basement containing the subordinate rooms.

No. 929,—"Babraham, near Cambridge, recently erected for H. J. Adeane, Esq.,"—P. Hardwick,—gives us a different specimen of the architecture of the Elizabethan period, more corresponding with the general character of our old English mansions of that and the preceding era;—less Italianized, and, if we may so express it, less *townish*. Here, instead of horizontal lines of panelled parapets, we have gables; and instead of upright windows, uniform in size, and regularly arranged, have smaller windows, intermixed with spacious bay ones divided into compartments. The house is chiefly of red brick, with stone dressings; but the central compartment, or *frontispiece*, in which the entrance is placed, is entirely of stone, and more Italianized than the rest, being decorated with small pilasters, &c., as is frequently the case in houses of the kind here imitated. Although rather plain upon the whole, the style is good, and marked by a soberness which, as it unfortunately happens, does not always accompany the other quality just alluded to. The drawing itself, too, is a very good one; but, if it be correct as a portrait of the place itself, it does not say much in favour of the situation of the house, for it conveys the idea of its being a bare and unsheltered one; neither does the small entrance court, formed by a mere dwarf wall before that front of the building, tend at all to improve the general effect either in drawing or in reality, but would rather seem to indicate that some public road passes immediately in front of the house, consequently renders such separation from it necessary.

No. 1029, by the same architect,—"The Bishop's Palace at Hereford, with proposed alterations,"—is by no means so satisfactory as the preceding subject. As to what the proposed alterations may be, we are ignorant, no sketch being subjoined of the building in its actual state, as in Mr. Barry's drawing of Highclere; but, were we not so informed by the catalogue, we should never have suspected this to be an episcopal palace, or any part of one, for it has much more the air of what is now termed a cottage, with its mock humility and its mock Gothicizings.

No. 951,—"Design for a mansion proposed to be built at Butterton Park, Staffordshire,"—T. Hopper,—is another mansion in what, for want of a more exact term, we may call the Elizabethan fashion, yet certainly not a very favourable specimen. It may be that we are rather prejudiced against it by the repulsive leaden coldness of the drawing; but even in itself the design is heavy and uncouth, and not only devoid of architectural beauty of any kind, but also of any thing to recommend it as a convenient and elegant residence within, no promise of refined taste in the latter respect being made by the exterior. Did such a building exist, we might feel interested in it as a picturesque object, and a specimen of the taste of bygone times; but the pleasure which under such circumstances it might afford gives way to a very different kind of feeling when we know that all its uncouthness and other defects are voluntarily adopted, *par preference*, and in lieu of something better suited to the character and purposes of modern residence.

[TO BE CONTINUED.]

DREDGE'S TAPER-CHAIN BRIDGE.

In our number for June we alluded to what we consider a very great improvement in suspension bridges, and one which, in mountainous countries, and where there are deep ravines especially, would be found one of the greatest acquisitions which has been attained in this department of bridge-building, ever since the cohesion of malleable iron has been employed in these most useful structures. In that number, however, we alluded to the subject only incidentally, and in connection with bridges constructed of other materials, upon different principles; and therefore it still remains to consider the merits of Mr. Dredge's invention as in themselves peculiar, and forming, as we cannot help thinking they will form, quite an era in this most important branch of architecture. England can produce more iron, and produce it at a cheaper rate, than any other country in the world; and therefore every fresh improvement in the application of iron must be regarded as a great national advantage, far exceeding the individual gain that it may yield to the parties contriving it, bringing it forward, or carrying it into execution.

Feeling thus, we cannot help saying that Lord Western and those other high, honourable, and likewise discriminating noblemen and gentlemen, who have taken, and are still taking, a very great interest in Mr. Dredge's improvement, serve their country much more than those "sounding brasses," of similar name but most dissimilar nature, who labour to say every thing and yet contrive to do nothing. The attention which these noblemen and gentlemen are paying to Mr. Dredge's invention is the more creditable to themselves, and the more valuable to the country, from the fact that there is, on the part of the profession, and of scientific men generally, not only an indifference to the improvement itself, but a pretty obvious disposition to do what is usually called "throwing cold water upon it." It is true that Mr. Dredge does not belong to the profession, or lay any claim to a niche in which avowed science deposits her mummies living or dead; and this, in conjunction with the pretty common feeling that nobody has a right to invent any thing but themselves, may tend to warp their judgments, which every one knows are very straight. But we "guess" that the bounty of Heaven, even in its most chosen gifts, is as free to all mankind as the breath of life; and if the really useful inventions were mustered, we rather think that the unprofessional ones would beat the professional by an overwhelming majority. We freely admit that professors profess to a nicety; but alas for the practice; and we have known but one professor whom we would have trusted in engineering—the late Doctor John Robison of Edinburgh, and he acquired his practical knowledge in the British navy, and in the Russian service.

We have been led to the train of these remarks by having been present at some experiments performed by Mr. Dredge before the professors—or at least a portion of them—of the College of Civil Engineers, at Gordon House, Kentish Town, on Saturday, the 13th of last month. Several noblemen and gentlemen, not professionally connected with the College, we believe, were present, and they as well as the students appeared to take a deep interest in what was going on. Some of the professors, we suppose, for their names were unknown to us, and we suppose are but little known to any one else, took upon themselves the burden of catechizing Mr. Dredge, and some who put no question, carried on the manœuvre,

"With sly remarks of leering faces,
And annotations of grimaces."

But, so far as we could judge, the gist of their questions tended to show that they really knew nothing about the principle of Suspension Bridges, and wished to worm a little information out of Mr. Dredge. In all this we may be in error; for if even Homer nodded, plain people may sleep sound; but really from all that we have read, or seen, or heard, we would as soon think of growing an oak forest in a hot-house, as breeding a corps of civil engineers in a college. No mean poet, in as far as nature, truth, and feeling are concerned, has the following appropriate lines:

"A set o' dull, conceited hashes,
Confuse their brains wi' College classes;
They gang in stirks, and come out asses,
The truth to speak;
And then they think to climb Parnassus,
By dint o' Greek.

"What's a' their jargon o' the schools,
Their Latin names for horns and stools;
'Gin honest Nature made them fools,
What sairs their Grammars;
They'd better tak' up spades and sho'ols,
Or knappin' hammers."

But waiving all these matters, or rather reserving them for a future opportunity, when we can consider them *per se*, we shall proceed to give a brief notice of the common-sense principle of Mr. Dredge's bridge, leaving the nicer points, and the transcendental problem which it involves, as very wholesome and appropriate exercises for the learned in such matters. Mr. Dredge's idea is purely a common sense one, that is, a following of nature, in as far as nature can be followed by art; and he who proceeds upon this ground will never find it fail under him, whatever the men of classes and mere book-learning may think about the matter.

The experiments which Mr. Dredge performed or repeated on the occasion alluded to, illustrated, in a very satisfactory manner, both of the principles in which the essence of his improvement consists. These are, First, the diminution of the suspension chains, from the abutments to the centre of the pendent curve; and, Secondly, the oblique position of the rods by which the railway is suspended. The

diminution necessarily implies so many bars or rods in the abutment-link as there are links in half the chain; and from this the number diminishes by one at a time, until a single one only remains at the centre, or, in the case of an even number, till two single ones meet there.

The first thing to be considered in order to understand the principle of the diminution, or rather the saving, of power and materials effected by it, is the diminution of leverage toward the centre. Now, if we suppose a bridge, that is, each chain of a suspension bridge, to consist of forty links, each rather more than ten feet long, so as to give a span of four hundred feet between the points of suspension, we shall have as good an example as is necessary for explaining the principle. We shall farther suppose that there are four such chains; and, having done so, we shall compare the weight and leverage in the case of uniform chains with the same number of bars, that is, twenty in each link, and with the bars diminished from twenty at the abutments to one at the centre. The weight of each bar in such a case as this may be estimated at about a fifth part of a cubic foot of thoroughly hammered iron, which is just about one hundred-weight to each bar. In the chain without taper there are twenty by forty, or 800 bars, and consequently 40 tons weight of iron or 160 tons in all the four chains, without any reference to leverage. With the taper there are 420 bars in each chain, or 21 tons in each chain, and consequently 84 tons in the whole. Deducting this from 160, we have 76 tons less in absolute weight, and consequently saving of material upon the taper chains, which is 97½ per cent. in the total cost of the chains.

This, however, though great, is only one item of the advantage; and we shall find our next one by taking the absolute weight and leverage jointly, and it is here that the grand merit of Mr. Dredge's invention lies. In order to understand it let us take half a chain, or 20 links; and in the case of the chain without taper there would be 20 bars in each, and the leverage in the ratio of the numbers 1, 2, 3, and so on up to 20: taking the sum of the product of these, we have 4,200, or, according to the estimate which we have made, 210 tons for each half chain, or 420 tons for a whole chain, or 1,680 for the weight and leverage of all the four; and, multiplying by the same numbers as before, we have 770 for each half chain, or 77 tons for each whole chain, or 308 for all the four, instead of 1,680, which is the weight and leverage of the chains without tapers. Therefore the absolute saving in weight and leverage, is 1,372 tons on the whole bridge, or considerably more than four-fifths of the whole; and be it remembered, that this enormous weight and leverage is wholly a dead weight, having no other tendency than to break down the bridge. Consequently, if the chains are relieved of this weight by the taper, the remaining chains will be as strong as the untapered ones, if they are reduced in the same ratio; so that taper chains, equally strong as to bearing weight with chains untapered, and requiring 160 tons of iron, may be made out of 32 tons. This is a saving of four-fifths of the iron in the chains; and the abutments, and all the other supports of the chains, may be diminished in the same ratio. Such a saving as this, in the increased span to which, in consequence of it, chain-bridges may be extended, renders the improvement of Mr. Dredge in them, comparatively, as great as those of Watt in the Steam Engine.

In chains of uniform dimensions throughout their whole length, and of the span and volume which we have supposed, the weight and leverage of the several links, taken individually, and without reference to the others, begins at 20, at the links next the abutments, and increases to 400, at the two links which we have supposed to meet each other at the centre. It is true that this vast accumulation toward the central part is propagated as a strain upon the abutment ends; and in Mr. Dredge's experiments with uniform chains upon the occasion alluded to, the fracture, when the model was loaded with the weight of nine persons, took place at the abutment, clearly showing that the whole strain was there.

In the taper chains, as we have described them for the same 400 feet span, the weight and leverage of the abutment links are also 20, and those of each of the two centre links exactly the same. The weight and leverage increase from the abutments in the middle upon each half of the chain until on the 10th and 11th links, they amount to 110, which is not a great deal more than one-fourth of the tension upon the central links of the chain of uniform thickness. This, of course, makes the natural curve of the chain deviate from the catenary of a uniform chain, by having more curvature towards the middle of each half, and less towards the centre of the entire chain. In consequence of this, there is more strain upon the central part than on the abutment-ends; and, therefore, in the experiments the single wire at the centre was the part that gave way, though it bore twice as many persons as the uniform chain of the same number of links at the abutments.

This shows clearly that the taper chain has at least twice the strength of the uniform one; indeed, it has more, for the uniform chain gave way when the nine persons were standing still upon it; whereas, the eighteen persons on the taper chain had to jump before they could produce a fracture, and the jerk occasioned by this must have had the effect of a good deal more still weight upon the bridge.

That the taper chain is, however, imperfect, if the roadway is suspended by vertical rods, is obvious, and was clearly shown by Mr. Dredge in a model constructed for this purpose. This model consisted of the chains, with a spring-beam, or steel yard at the centre, a flexible piece of timber for the roadway, and strings for the suspension rods, which could be arranged either vertically, as in chain bridges of the old construction, or diverging from the centre as in Mr. Dredge's improvement. When these were arranged vertically, and the roadway pressed down, the strain was thrown towards the centre of the chain, as was shown by the action of the spring, which, when Mr. Dredge pressed down the roadway with both his hands, indicated a weight of 30 or 40lbs., straining on the centre. When, however, the suspension cords were arranged obliquely, or converging towards the centre at their lower extremities, the whole chain was brought into action; and though the roadway was pressed down with equal or even greater force than in the former case, the spring steel yard remained quite loose, thereby showing that there was not a single pound of tension on the central part of the chains. This bringing up the whole chain into action, to whatever part of the roadway the weight is applied, is a most important feature of Mr. Dredge's invention, and one which it does not appear that the professedly learned in the doctrine of statics are very able, or at all events very willing, to understand; but that is no good reason why the benefit of it should not be understood, appreciated, and turned to practical account by the public, and especially by all who have an interest in the erection of structures of this kind. To the public, and the parties immediately concerned, it is a matter of small moment whether the inventor of that which is useful is, or is not, a professional engineer, or a man whose name is enrolled in the list of science, and is entitled to his dividend in the joint stock institution of mutual and reciprocal praise, local or national. In an age of joint stock companies, and when the march of common men is treading somewhat closely on the robes of the professional, folks begin to take note of their little flaws and fissures, it may be very well for them to exercise their wits and their mites for mutual and reciprocal laudation; but the day is not very far distant when a discerning public, awake and arising, as that of Britain — and we may say of every civilized country, is at the present time, shall laugh at those small fooleries of the wise. We make these remarks without the least admixture of any angry feeling, though not without much sorrow; and we have been in part led to them by having heard it surmised that Mr. Dredge had no small difficulty in obtaining a hearing before the British Institution. "Is Saul also among the prophets?" asked every sapient member, whose name flared in the list with letters after it as long as the tail of a comet; and though they could not refuse to acknowledge the sterling value of Mr. Dredge's improvement, they seemed to do so with a grudge that it should have been made by any other than one of themselves. This will not do, however. Superstition and tyranny may, as they have done before, lay their taboo upon the emanations of genius; but, if ever pretended philosophy dares to set a seal upon any man's understanding, the vital principle of intellect melts the way, and poor pretended philosophy gets her fingers burnt.

But to return once more to the taper chain-bridge, with the roadway suspended by rods converging toward the centre, we have shown that in a structure of this kind, four-fifths of materials may be saved, and yet greater strength and durability secured, than in a chain bridge upon the common principle; and these we feel convinced are sufficient grounds of recommendation to the public. We have taken a plain common-sense view of the matter, and what we have stated is borne out by the facts. Whether they who profess to be learned in

such matters do, or do not, understand the principles of the bridge, according to the usual formulary of their understanding, is a matter with which we have no necessary concern, only we cannot help remarking that the questions put to Mr. Dredge, by the professors, as we suppose, of the College of Civil Engineers, struck us as evidence that they knew very little about the subject, and were anxious to conceal it. The interest taken by the students was quite of a different character, and so was that taken by the Earl of Devon and Lord Western; and it reflects great credit on the latter of these noblemen, that he has exerted himself so strenuously in getting this improvement brought before the public. His letter to Lord Melbourne may not have produced much effect in the quarter to which it was addressed; for British ministers are, by long prescription, dry nurses of the arts and sciences; and, farther than this, there is something about the stool that a minister occupies which tends greatly to prevent him from rising to any thing eminent in that way — the stool seems to be so ricketty in the legs, that if the minister once rises, down goes the stool, and another snatches it, and seats himself before the former occupant knows what he is about.

Therefore, it is to the public that inventors and all men of talent must look not only for their reward, but for that chance of reward which nothing but publicity can procure for them; and the more that any project is sifted, and even found fault with — so that it is done openly — it is the better, because the objectionable parts can thus be corrected, and the commendable ones improved. For this reason, we should be very glad to see a thorough investigation of Mr. Dredge's bridge, undertaken by some competent engineer, or man of science, and which should proceed upon principle without opinion. This is a debt which they unquestionably owe to the country, and the sooner it is discharged the better.

ON THE COMPARATIVE EFFICIENCY OF IRON-BUILT AND TIMBER-BUILT SHIPS.

THOSE who take any interest in naval affairs will have observed for some time past notices and remarks in the public journals respecting vessels built of iron. It appears probable that this material will almost entirely supersede timber in the construction of boats, barges, steam, and the smaller classes of sailing vessels. Any information, therefore, relative to the building, quality, or the comparative increase of safety or danger, by the substitution of iron for timber in such craft, must be worthy of notice. The Nemesis, a steam vessel, of nearly 700 tons burden, and built of iron, has been lately docked at Portsmouth, for the purpose of having some damages repaired which she had sustained by striking on a rock off Scilly, when on her passage from Liverpool to Odessa. This afforded a favourable opportunity for obtaining an insight into the details of an iron vessel, while the courteous behaviour of the gentleman who built her, and the officer who commands her, giving every information in their power, removed all difficulties.

The dimensions of the Nemesis are as follows:—

Length between the perpendiculars	165 feet.
Length over all	184 „
Length between stem and taffrail	173 „
Breadth	29 „
Depth	11 „
Burden in tons	660 „

The keel plate was laid in August last; the vessel launched in November, her engines put on board and tried in December, and she was ready for sea by the middle of January. The vessel is built almost entirely of iron, the exceptions being — the planksheer, or gunwale, which is of oak, four inches thick and ten broad, brought upon and secured to a planksheer, or gunwale, of angle iron,—the flat of the deck, which is of three inch fir,—four beams under the deck, nine inches square. These are forward, and support the carrick-bitts, paul-bitts, and the foremost gun. The remainder of the beams, with the exception of the paddle-beams, which are of oak, twelve-inch sided, and fourteen-inch moulded, are of iron. The knee of the head, the rudder, the paddle-boxes, and a light berthing above the gunwale, about two feet eight inches high, are of wood. The coamings and fittings upon deck are generally of wood; although for these purposes more iron is used in the Nemesis than in timber-built vessels. The cabins and fittings for the officers, passengers, and crew, are of wood, and are very neat and handsome.

The mean launching draught of water, with masts, yards, rigging, anchor, and cable, with the cabin fittings in a forward state, was two feet four and-a-half inches. The mean load draught, with twelve days' full supply of coals,—water and provisions for a crew of forty men for four months, and three years ship's stores of all sorts, with duplicate and extra machinery, is stated to be six feet. The engines were made by Forrester and Co., Liverpool, and are of one-hundred-and-twenty horse power. The diameter of the cylinders is forty-four inches, and the length of the stroke four feet. The framings are of wrought-iron. The boilers may be worked either separately or together. The paddle-wheels are seventeen feet six inches diameter to the inner edge of the rim. The floats, which are sixteen in number, are six feet nine inches long, and fourteen and-a-half broad. The paddle-shaft is seventy-eight abaft the fore-end of the water-line. The vessel carries two thirty-two-pounder medium guns, one forward and the other aft, on pivot-carriages, to fire over all. And it is this which constitutes one of the chief points of interest in the Nemesis. The guns have been fired several times, with an extra charge of powder and double-shotted. The concussion has left no visible traces on the vessel; and the experiment, as far as it has yet been carried, certainly does not militate against the adoption of iron in the construction of ships for war.

The fore-mast rakes two feet in twenty, and is thirty-two feet abaft the fore-end of the water-line. The main-mast rakes one foot in twenty, and is one-hundred-and-eleven feet six inches abaft the fore-end of the water-line. The bowsprit steaves five feet six inches in twenty feet. The following are the dimensions of the spars:—

	feet.		inches. diameter.
Fore-mast from deck to hounds	42		15
Fore-mast from head	8		
Main-mast from deck to hounds	42	6 in.	15
Main-mast from head	8		
Fore top-mast	24		10
Fore head	4		
Sliding gunter-mast	28		6
Sliding pole	8		
Main top-mast	33		10
Main pole	13		
Fore gaff	23		7½
Main gaff	23		7½
Fore-yard cleated	52		10½
Fore-yard arms	3		10½
Fore topsail-yard cleated	36		8½
Fore topsail-yard-arms	2		8½
Fore topgallant-yard cleated	25		6
Fore topgallant-yard-arms	1	6 in.	6
Bowsprit, out-board	21		15
Jib-boom, out-board	13		8
Jib-boom, in-board	13	6 in.	

The form of the midship section is an oblong, eleven feet in depth, and twenty-nine in breadth, with its base curved downwards, six inches in fifteen feet, to the middle line of the keel; its sides slightly curved outwards, and the lower corner rounded off in the arc of a circle to a radius of about three feet. The midship portion of the body, in which the engines, boilers, and coals, lie, preserves much the same section throughout its length. Forward and aft the form becomes finer, and gradually approximates to the usual bow and stern of sailing vessels. The stern-post is plumb. The stern rakes forward of the perpendicular at an angle of 16 degrees.

With respect to the method of connecting the various parts, strictly speaking there is no keel, although the lower plate of iron which connect the two sides of the ship, and which is about one foot in breadth, is called the keel-plate. This plate is slightly curved, with its convex side downwards, so as to form a channel for water in the direction of the length of the vessel under the floors. The floors are straight bars of angle iron, with one flange, four inches wide,

lying horizontally; the other nine inches deep, hanging vertically. The vertical flange is connected to the bottom plates of the ship by three-inch angle iron,—that is, angle iron of three inches width of flange. Upon the upper surfaces of the floors, five ranges of sleepers, of timber twelve inches square, and extending the whole length of the hold of the ship, are laid and securely bolted to the horizontal flanges of the floors, by one-inch bolts, their points secured under the flange of the floor by nuts at these points. The frames, which are of angle iron three inches wide, are eighteen inches apart along the mid-ship body of the vessel; but forward and aft this space is gradually increased, until they become about three feet apart. The rivets by which the plates are secured to the frames are put in from the inside of the vessel, and are clenched flush on the plate; the outer part of the hole through the plate being counter-sunk to receive the rivet, so that the bottom of the vessel is a perfectly even and smooth surface. The whole of the rivets are heated to a nearly welding heat: therefore, the contact between the surfaces of the iron is exceedingly perfect, as it is insured not only by the care applied to the rivetting, but by the contracting of the rivets in cooling. The frames run up to, and end upon, the iron gunwale. This is of three-inch angle-iron, with one flange horizontal, to which the four-inch wooden gunwale is secured by screw-bolts; the other flange is vertical, and to that the upper ends of the frames are rivetted. Between the wood and the iron forming this compound gunwale, felt is laid, which is so firmly compressed by the screw-bolts that the joint is perfectly water-tight. The ends of the beams are secured to the sides by angle iron knees. The paddle-beams, of timber, pass the sides of the vessel through what may be called sockets, formed by bars of angle iron placed above, below, and on each side of them. One flange of each bar is firmly rivetted to the planking of the vessel, and the other flange is secured to the beam by screw-bolts. Felt is also inserted here in the joints between the wood and iron. The stem is of sheet-iron. At the lower part of the stem there is a sort of a socket of iron which forms the gripe, and in which the lower end of the wooden knee of the head is inserted.

The sheets of iron which form the planking of the vessel are about eight feet long, and two feet six inches broad. Of course these dimensions vary according to the place of the sheet in the body of the vessel. The lower six strakes which form the bottom, and extend from the keel-plate to the turn of the bilge, are clinker built. The strake at the turn of the bilge, and the five strakes which form the side of the vessel from this turn upwards, are carvel-built. The lands of the clinker seams are rivetted with three-quarter iron rivets, similarly to the lands of a clinker-built boat, without any strengthening bands. The carvel seams, and the buts of both clinker and carvel strakes, are secured by bringing the edges of the plates in contact, and rivetting each edge to a strip of plate-iron, lying on and lining the inside of the joint. The seams are caulked by closing the edges of the two plates together with blows of a cold chisel. The whole of the rivets are flush on the outside of the vessel. The keel plates are seven-sixteenths of an inch in thickness. The clinker-worked plates covering the bottom of the vessel are three-eighths of an inch in thickness, and the carvel-worked plates, covering the top-sides, are from five-sixteenths to a quarter of an inch in thickness. The iron work is first painted with several coats of red lead, and then varnished with a patent varnish. This covering to the iron did not appear to be at all disturbed on any part of the bottom, excepting where it had been rubbed off by the rocks on which she had grounded.

There are several peculiarities in the internal arrangements of the vessel. The whole internal space is separated into seven water-tight compartments by six iron athwartships bulkheads. Four of these, those in the wider part of the vessel, are of five-sixteenths of an inch iron. The bulkhead nearest to each extremity, being of small surface, and liable to less immersion, is only three-sixteenths in thickness. The wooden sleepers necessarily pass through each of these bulkheads, and they are secured where they pass through, by strong flanges bolted down to them over felt, and rivetted to the bulkheads, so that no water can possibly pass from any one compartment to the other. Therefore, a leak which may be sprung in any part of the bottom of the vessel can only affect that compartment between the bulkheads of which it happens. Thus the damage caused by the rock on which she struck, admitted four feet of water into the compartment in which it occurred before the leak could be stopped, but there was none in any other part of the vessel. There is a small hand-pump fitted to each compartment, the pipe from which leads into the hollow of the keel-plate. Large pumps are not necessary, as the compartment can only fill to the level of the external water, and may then be emptied at leisure; or, if the leak be greater than the discharge of the pump, may remain filled until a port is reached.

In the space between the engines and the boilers, usually called the stokehole, there is a very ingenious means adopted to strengthen the body, without interfering with the accommodations of the engine-room. This is the introduction of a partial bulkhead with an aperture bounded above by an erect, and below by an inverted arch of bar-iron; thus supplying by mechanical contrivance the support which otherwise could not be obtained for this part of the body, without great inconvenience. To obviate the disadvantages attendant on the small draught of water which this vessel draws, there are two sliding keels, similar in principle to those which were originally proposed by Captain Shank, of the Royal Navy, when in command of the British force on the American Lakes, during the War of Independence. These keels are each seven feet long, and capable of being protruded five feet below the keel of the vessel. They are of wood, four and-a-half inches thick, and each works up and down, by means of a small windlass and an endless chain, in a water-tight case or trunk twelve inches wide, formed, like the rest of the bulkheads, of sheet-iron, and running from the bottom of the vessel up to the deck. The plates of these trunks are seven-sixteenths of an inch thick, and they are strongly secured by angle iron to the athwartship bulkheads, which they also serve to support. The report of the officers on the advantage which they derived from these keels, when under sail, in enabling them to keep the vessel up to windward, and in keeping her steady, is very favourable. In fact, they are an ingenious modification of the lee-board. One of them is situated just before the engine-room, and the other just abaft it. There is also a contrivance by which the depth of the rudder in the water may be increased whenever these sliding keels are used.

Having now described the vessel, we will proceed to describe the damage she sustained by striking. When she struck, her speed is reported to have been nearly nine knots; her average speed was eight and a half. The first blow was evidently received exactly in the centre of the front of the fore-foot or gripe, which was dented-in about three inches, and split about eight inches in its length. This blow must have been inflicted by a rock at least as sharp as the pea of a moderate sized anchor. The blow appears to have been repeated under the keel plate, about seven feet abaft the fore foot, but there it only occasioned a slight, though long indentation. The principal damage was on the starboard side under the bilge, and at the station of the foremast bulkhead. The outside plate or planking was cut through by the blow having forced it on to the edges of the bulkhead plates; and the lower plate of the bulkhead was broken by this pressure. The wooden sleeper, which lay on the iron floor almost directly above the blow, was started up one and a half inches from off the floor, and the iron bolt which secured it to the floor was broken.

The blow to have produce such damage as has been described must evidently have been very severe. It apparently clearly establishes that the injury affects the part struck only, for the rivets seem to have held as tight, and the contiguity of the plates of iron to have remained as perfect after the blow as before it had occurred, excepting only the plates cut by the bulkhead. There might have been a very rational doubt, before the experience this accident has afforded, whether, under such an injury, sheets of iron would not have rent almost as sheets of paper would tear; and whether the rivets would not have started by the dozen at a time, as the stitches in the seams of a sail. Several of the plates abaft the cut plates were indented in a long wavy indentation. The greatest depth of the indentation occurred at the cut, where it was three and a half inches. The injuries were repaired by placing a shoe over the fore foot, somewhat similar in shape to the shoe used to drag the wheel of a carriage when going down hill. This shoe was rivetted strongly by rivets passing through it and the gripe, from side to side. The two plates of the bottom which were cut, and the plate of the bulkhead which was broken, were taken out by punching out the rivets, and new plates were substituted for them. Those plates which were only indented were taken out, straightened in the fire,

and replaced. A small quantity of the angle iron framing, connecting the bulkhead to the bottom was also removed, and substituted by new. The weight of new materials used in the repairs was under 3 cwt., and the expense for the materials and wages of the smiths and rivetters about 30*l*.

It is not easy to institute any comparison between the expense of this repair and that of a similar accident to a timber-built ship; because we cannot ascertain what would have been the extent of the damage. If any timbers had been broken, which would in all probability have been the case, the expense would have been much greater. But unless timbers had been broken, the mere upsetting of the gripe of a ship, the rubbing off of a few sheets of copper, and the shifting of a plank or two, would not have involved expense much exceeding that of the repair of the Nemesis.

Before the vessel was grounded upon the blocks, sights were placed towards each extremity, one hundred and forty feet apart, with a third sight between them. By means of these sights observations were taken before and after grounding, and the deviation from the straight line, in the length of one hundred and forty feet, was only a quarter of an inch.

Two questions now naturally arise:—First, What are the advantages or disadvantages of the substitution of iron for timber in the construction of ships? And, secondly, to what limit may this substitution be advantageously carried? Among the advantages are the employment of a less costly material, of which the supply is inexhaustible, and for which supply we are totally independent of other nations. Also the greater durability of the material, not only arising from its relative durability with that of timber, but from its requiring no metallic sheathing to protect it from the ravages of worms. Also the greater durability of the structure as a whole, in consequence of the greater permanency in the perfect combination of its several parts; arising from the fastenings being of the same hardness of texture as the portions of materials brought into connection. The metallic fastenings to a timber-built vessel act, it must be remembered, not only chemically, but also mechanically, to accelerate her destruction, immediately the close connection of the several parts is at all diminished.

These appear to be the principal advantages of iron in connection with the question, as far as first expense of material and durability are concerned. But these considerations are independent of the expense in relation to the comparative total quantities of materials required to build a ship of each sort. For it must be remembered that the iron-built vessel is of iron alone, the timber-built vessel is of timber, iron, and copper. Were it possible to compare an iron-built ship with one entirely built of timber, setting aside the question of durability, undoubtedly the advantage would be wholly on the side of the timber-built ship. For the strength of oak is one-fifth that of wrought iron, and its weight is only one-eighth that of wrought iron. But this comparison is untenable, because of the great quantity of metal which necessarily enters in the construction of the timber-built ship; by which its relative weight is very much increased, and its relative strength diminished. By the term "timber," in speaking of a timber-built ship, a compound of timber, copper, and iron is meant, having less strength in proportion to weight than the timber alone, but greater weight in proportion to strength. It is impossible within the limits of this paper to investigate the actual weights of wood, iron, and copper, which enter into the composition of a timber-built ship, in order to ascertain the exact answer to the question as to which is the heavier material in proportion to its strength, the "timber" of the timber-built ship, or the iron of the iron vessel. We shall, however, assume as correct that which we believe would be found to be so, viz., that the material of the timber-built ship would be the heavier in proportion to its strength, and shall proceed to the farther investigation of the original questions on that assumption. Therefore, by the substitution of iron we obtain equal strength with less weight of material. From which advantage it follows that, if the "timber" and the iron vessel be each loaded for the same loaded displacement, the iron vessel, with equal strength will be capable of carrying a heavier cargo, and with greater strength an equal cargo. Also, that if a "timber" and an iron vessel be built of the same strength, and to carry the same weight of cargo, the iron vessel may be of less displacement, and consequently smaller in dimensions, or if of less displacement with the same dimensions, may be more advantageously formed for velocity and for weatherly qualities. The small dimensions involve the advantage of light draught of water, diminished expense, and less numerous crew. The diminished displacement with the small dimensions involves quicker return of capital and greater safety in navigation.

The answer to the second question, as to the limit in the size of the vessel to which the substitution of iron for "timber" may be carried, appears also to be involved in the foregoing considerations. For, if greater strength may be obtained with equal weight of material, or equal strength with less weight of material, there can be no limit short of that limitation which may equally apply to "timber." And, by an application of the foregoing reasoning to the question at issue, it appears that a first-rate may be more strongly built of iron than of timber, with the same light displacement,—and equally strongly built, but capable of carrying a greater quantity of water, provisions, and stores, with the same load displacement; and equally strongly built, and capable of carrying an equal quantity of water, provisions, and stores, with a less load displacement. This may appear to be a bold and startling result of our investigation: but, if our original assumption be correct, it is, nevertheless, within the bounds of truth. Nay, it is even an under estimate of the limit to the substitution of iron for wood in the construction of ships. For the limit to the possibility of constructing a fabric of any conceivable dimensions is necessarily dependent upon the ratio of the strength of the material used to its weight. And as this is greater in iron than in the "timber" of the timber-built ship, the limit of dimensions for the iron-built ship is more extended than the limit of the dimensions of the timber-built ship. It may, perhaps, be necessary to repeat that the word "timber" in this investigation means the copper, iron, and wood of the timber-built ship.

The question of the durability of these vessels, of their little liability to accident, and of the ease with which damage done to them may be repaired, appears to be very clearly proved from the experience which has already been obtained on these points; and this is not little, for there are boats built in both North and South America—in all parts of India, and on the Euphrates and the Indus—in Egypt, on the Nile—and in the Mediterranean—on the Vistula, on the Shannon, and on the Thames. One of these boats on the Savannah has been constantly at work for these last six years without any repair; which is a great test, if we consider the frequent constant caulkings required to preserve a timber-built ship. There is also a steam-yacht built of iron—the Glow-worm—the property of Assheton Smith, Esq. This vessel has made the passage from Bristol to Carnarvon—a distance of 210 miles—in eighteen hours. In the Report to the House of Commons on Steam-Vessel Accidents, we find the following stated of the Garry Owen, one of these vessels:—"We went ashore about two cables' length to the eastward of the pier (Kilrush), and struck very heavy for the first hour. The ground under our weather-bilge was rather soft clay, covered with shingle and loose stones, some of them pretty large. Under our inside, or lee-bilge, the ground was very hard, being a footpath at low water. I was greatly afraid she would be very much injured by it in her bottom, but I am happy to say she has not received any injury; in fact, her bottom is as perfect and as good as on the day she left Liverpool—not a single rivet started, nor a rivet-head flown off. If an oak vessel, with the cargo I had on deck, was to go on shore where the Garry Owen did, and get such a hammering, they would have a different story to tell. . . . Out of twenty-seven vessels that got ashore that night, the Garry Owen is the only one that is not damaged more or less."

Colonel Chesney, the commander of the Euphrates expedition, writes thus of the iron vessels which were employed on that service:—"It is but right to tell you that the iron vessels constructed by you far exceeded my expectations, as well as those of the naval officers employed in the late expedition, who would one and all bear testimony anywhere to their extraordinary solidity; indeed, it was often repeated by Lieutenant Cleaveland, and the others, that any wooden vessel must have been destroyed before the service was one-half completed—whereas the Euphrates was as perfect when they laid her up at Bagdad as the first day she was floated. As I am now occupied in preparing a work on the expedition, I shall have a better opportunity than the present of doing justice to the subject of iron vessels, for it is my belief that they will entirely supersede wood, on account of their comparative strength, cheapness, and durability, whenever people are satisfied that their only disadvantage—the free working of the compass—has been overcome.

"In the Euphrates, which is entirely of iron, there was a variation of about 10°, and that with little change, but the compass worked very sluggishly, and required extreme care.

"In the Tigris, with the upper part (as you know) of wood, it worked freely; indeed, as far as I could judge—and I had a great deal of practice, taking bearings for the survey—as well as in any ordinary vessel; and if we had placed the compass as far *above* the iron in the Euphrates, as it happened to be by chance in the Tigris, I think it would have worked quite as well."

The effect of the iron upon the compass appears to be one of the most serious objections to these boats, for although Colonel Chesney's letter is even on this point favourable, it is not conclusive. There is some doubt, indeed, whether the accident which happened to the Nemesis may not be attributed to her compasses. There is local attraction in all ships, in consequence of the great quantity of iron used in their construction and in their armament. To obviate the inconvenience, and even danger, which might arise from this, Professor Barlow proposed to ascertain experimentally, for each ship, the amount of this local attraction, and to counteract it by a plate of iron, placed so as to have an equal but an opposite effect on the needle. Several ships, especially those destined for the surveying service, have been fitted with these plates. In the Nemesis, magnets are used to exert a similar counteracting influence on her compasses; probably because it was thought that Barlow's plates would not act with sufficient energy to counteract the local attraction of such a vast surface of iron; and also because the form of Barlow's plate appears objectionable, in so far as having its broadside turned towards the compass, it occupies a considerable arc of azimuth. Professor Airey prefers a long box, filled with iron chain, as less likely to possess the permanent magnetism from which no plate iron is free. There is one experiment, which was tried in connection with the fitting of Barlow's plates, which might possibly be brought to bear upon the question of the local attraction of these iron ships. It is this:—about thirteen or fourteen years ago, the Phaeton, a frigate, was fitted with a mainmast and a bowsprit, both of iron, and there was great anxiety as to the effect of these large surfaces of iron on the compass. Barlow's plates were consequently ordered to be fitted. The ship was experimented upon, in order to determine the amount of the local attraction; when, much to the astonishment of all interested in the question, it was found that, at the station fixed upon for the site of the compass, the mast and bowsprit had evidently a correcting influence to that of the other iron-work in the ship. The result of which was, that the local attraction, as determined by experiment, was so very inconsiderable that it did not even come within the limits of the attractions obtained by Professor Barlow for his plates. Now, to apply this to the case of a ship wholly of iron—may not that exact spot be found by experiment in an iron ship, which was found accidentally in the Phaeton, at which the influence of the total amount of all the attractions is nothing?—that is, the common centre of all the attractions. In all probability, this spot might not be at a convenient distance from the wheel, but that is of very minor importance. It would be sufficient for safety, if there were one compass on board of a ship which could be relied upon as being correct, since a reference to it might always be made. It may be objected that the experiments to ascertain this precise spot would be too extensive and tedious. The placing the magnets, which are at present fitted on board of the Nemesis, required nearly a month of preliminary observations and experiments. To any one who has assisted in conducting the experiments by which the position for Barlow's correcting plate is determined, it certainly must appear that to ascertain the centre of attraction in a ship would be attended with far less difficulty than must have been experienced in the case of fitting these magnets. In the months of October and November, 1835, a series of experiments was made by the direction of the Board of Admiralty, under the superintendence of Commander Johnson, of the Royal Navy, upon one of the iron steam vessels built by Mr. Laird, the Garry Owen. By these experiments the amount of the deviation of the compass in various parts of the ship was determined; and a very curious fact appears to have been established, which was, that the vessel itself had become magnetic to a very considerable degree. The experiments appear to have been directed to the discovery of the most advantageous position in which to place a compass, and to remove it to such an elevation above the deck as to avoid the separate actions of particular portions of the iron-work, that the joint effects of all the iron in the vessel might be resolvable into one force, to be discovered and counteracted either by Barlow's plate or by a magnet. But the common centre of all the attractions, or, in other words, the point of no attraction, does not appear to have been the subject of inquiry—whether, when found, it would be at all applicable as a station for a compass must depend upon its locality.—*United Service Journal.*

THE ANALOGIES OF NATURE AND ART.

The pursuit of truth, distinct from other considerations, is accompanied by so supreme and elevated a pleasure and love of the noble and beautiful—that alone would bring "*its own exceeding great reward.*" But, independent of inducements for its own sake, the study of nature is so replete with useful application, and so much of "*the wisdom of our daily life*" is comprised in a just knowledge and estimate of her operations, that we cannot too often or too forcibly urge its importance and paramount necessity to all, but particularly to the professions we more immediately address.

Under these considerations, it has more than once occurred to us, that the inquiry would not be altogether devoid of interest or instruction, to trace the degree of subserviency existing in the rude arts of savage tribes, and the economy of nature as displayed in the habits and physical adaptations of the inferior animals. Man is strictly, beyond all others, an imitative being, and unquestionably to the strong developement of this principle of the human mind, the existence of all invention and improvement in the useful arts is mainly owing. But it is in the primitive and more early stages of society that man appears to be the most indebted to the suggestions of nature. In civilized life, "*the world is too much with us,*" and our minds amid the multifarious concerns of an artificial state, are distracted from the consideration of final causes to those which are merely secondary and immediate. It is not so with the simple denizen of nature, who, dwelling in the heart of her stupendous and wonderful operations, uninfluenced by extraneous objects, beholds at all times the manifestations of her power and wisdom with a brighter vision and a more perfect faith, and hence derives more frequent and important lessons for application, not only as regards the physical wants of his being, but also in many respects a juster moral conviction of the ever-regulating influence of Omnipotence, thus insensibly tending to the birth of that pure and perfect philosophy whose induction leads "*from nature up to nature's God.*"

In such a state, we need not remark how much of the necessities of his existence are dependent upon a strict and studious observation of natural phenomena, and from his "*habitual wanderings out of doors,*" a familiar and watchful acquaintance with the movements and habits of her more humble creatures. From which lessons he is enabled to acquire his daily provision of food and shelter with greater certainty, and at a far less cost of bodily fatigue than formerly, and generally, be it observed, with that facilitous adaptation of means to ends, which is the invariable characteristic of the Divine wisdom by which he is taught. Hence, we perceive, is gained one grand and important step on the road of civilization, viz., the essential economy of time and labour, and thus the very urgencies of our animal nature. The *incubi*, which too often, in a refined and advanced period of society, doom hopelessly to "*the langour of inglorious days*" the intellectual aspirations of many an ardent mind, become in the earlier history of a people the sole and vivifying principles from whence spring the germs of after refinement and knowledge, as it were the rude flint from whose hard contact the first bright scintillations of science are elicited. So, by this continual re-action in the world, of good against evil, the moral balance of human happiness is perpetually sustained.

Is it necessary to adduce instances of these or of the success and beauty of those results in civilized life, which likewise are founded upon an imitation of natural operations and an undeviating adherence to her laws? For the benefits of her teaching are not necessarily confined to the exigencies of a rude state. The stream of her instruction flows by the city as through the desert; so that all may equally drink of its waters; and some of the rarest and most perfect combinations of art have been the effect of a casual observance of her most simple processes: one or two instances, however, among the number, will best serve to illustrate our meaning; for facts speak

in a language infinitely more intelligible and convincing than mere dissertation, and constitute the best exponents of the proposition we wish to establish.

The quality of all creation is motion: in the world we live in, there is nothing but what more or less partakes of it; and to the existence of animated beings, more especially man, mobility is an indispensable condition. In all, nature has provided for the want, but we shall behold that man, not satisfied with what she has simply given him, multiplies his means by an imitation of the endowments of inferior creatures.

Navigation, as an art, is common to most tribes and countries contiguous to the ocean: but from all accounts, it was in the earliest history of the Egyptian and Phœnician nations that it first originated, and was carried to any degree of perfection. Before, however, either Egypt or Phœnicia even existed as a people—the *nautilus*, a small fish, common in the Mediterranean, had, both with sails and oars, been a skilful and consummate navigator of its coasts. Are we then deducing an inference altogether arbitrary, in supposing that from this little animal was derived the first point for making use of the wind as a prime mover in navigation.

But let us refer to a state of art anterior to this, and take the simple case of the means by which the savage nations of the Pacific propel their canoes,—who, by their insular situations, being chiefly dependent upon the ocean for the principal aliments of life, become in consequence unavoidably impelled to seek some effective, and at the same time easy method for traversing the seas which surround them. Now, in the absence of material for sails, which either imply certain favourable conditions of natural products, or, as we have before observed, a more advanced stage of civilization, man necessarily recurs to the physical conformation of the aquatic animals around him—for the means which their common mother, nature, has provided for locomotion in their destined element. Hence, the canoe-paddle took its present general form and modification, viz., the figure of the trapeze acting in the direction of its longest diagonal; and it is precisely that which constitutes at the present moment the most efficient steam-boat propellers we know of—we mean those recently adopted by Mr. George Rennie, under the denomination of The Trapezium and Canoidal. The latter being in some degree a combination of the former with the Archimedean Screw. Nevertheless, the principle, although excellent, we have long imagined to be capable of great extension and improvement in a more direct application of the method by which the fish effects its object, and the notion (which we have been led to understand has recently been carried out by a gentleman in Calcutta) was also that some years since of an ingenious friend of ours, but unhappily beyond a few drawings and experiments at the time, never fully realized. It will not be altogether uninteresting to trace home the analogy existing between all natural modes of propulsion; and this same trapezoidal figure would afford, if any were required, one more conclusive proof of the perfect universality of all nature's laws. Let us observe the tails of fish—the feet of all aquatic fowls—the fins of turtles—and even the wings of birds, and we shall perceive all, more or less, partaking of the above character. Any slight dissimilarity of structure, arising simply from that wonderful pliability of nature, of readily adapting herself to the peculiar wants and habitudes of different species—necessary conditions towards the fulfilment of certain specific objects of individual economy. But in all, the same mathematical figure pertains, and the forked serrated form observable in the wings of birds, and the tails of some fish, usually those endowed with greater capabilities of speed and activity, do not destroy the general affinity; the two exterior sides in such cases merely forming a *ventrant* instead of a *salient* angle: nor is it less worthy of our profound attention, the beautiful mechanical balance kept up in all between the power and resistance in that gradual diminution of the acting surface towards the extremities: the exemplification of which principle of conclative equilibrium we perceive in all natural structures, and was pointed out long since by Galileo. The reduction in the substances of trees towards their tops — the tapering figure of all plants — the hollow cavity in bones — stalks of corn, feathers, &c., are not only so many means of insuring additional strength and stability, but, at the same time, the greatest effect with the least expenditure of material — for nature is a true economist, or in the words of a living writer, "Creative power, infinite in its developement, is infinitely economized in its operations." Hence the judicious imitation of this in the casting of columns and girders, also, — the recent construction of the beautiful suspension bridge over the Avon, by Mr. Dredge, are but so many more instances of the invariable success attending Art when she follows in the footsteps of Nature.* By the way, can any thing illustrate so perfectly and beautifully the correct principles of the catenary or suspension bridge, with its system of tie and braces, as the web of the spider? When did science ever set about the performance of any work with more methodical precision, or upon truer geometrical principles? With what nice art and delicate adjustment is each separate fibre made to perform its proper individual function, and mutual relationship with the whole, and what strength, convenience, and beauty in the finished result. A careful study of this little workman's labours might yet teach us much to improve in the construction of our suspension bridges. Under any circumstance, we imagine that such would not be an indifferent school for the acquirement of the true principles upon which those works ought to be conducted.† The fable of the metamorphosis of Arachne, by Minerva, is not devoid of meaning; it but typifies the *wisdom* which first urged man to imitate the art of the spider. It is not, we believe, generally known that Watt derived from the formation of a lobster's tail the first hint of the flexible joint in his ingenious method for carrying pure water across the bed of the Clyde, thereby accomplishing easily, and at little cost, what otherwise would have implied a vast outlay of capital and labour. Again, from the mechanism of the human body how many ingenious modifications of machinery have not been effected. The elbow alone, with its simple and beautiful articulation and complication of movements, is a world of mechanical arrangements. It has been happily imitated by Mr. Collinge in the form of a hinge; and the common contrivance known as the ball and socket joint must be familiar to every one; but the following anecdote of all others bears with peculiar force upon the subject—it was related to us by a gentleman well known as an engineer, and the talented inventor of many works of much practical merit connected with the useful arts:—Some years back, having devised a method for cutting out by machinery the most complicated patterns and designs for inlaying floors and other purposes, there happened to be one consisting of a peculiar spiral, which all his ingenuity was unable to compass. After several trials, all equally unsuccessful, with every variety and combination of tools, he was at last induced to give up the attempt in despair: but having occasion, shortly after, to examine the state of some timbers in a wharf on the river, he observed that the incursions of a certain small and destructive worm had gradually worked a groove into the wood, bearing a striking resemblance to the peculiar spiral which had so long baffled all his efforts to imitate. A closer examination, to his great delight, confirmed the fact, and the mandibles of the animal suggested the construction and form of a tool which fully realized his most sanguine expectations; and so, the weak and despised worm, working in its quiet obscurity, became the humble instrument of accomplishing that, which all the resources of art and money had been unable to effect.

There is a rich and important moral derivable from this story, more particularly for the young, whatever his station and pursuit in life; it tells him at all times to guard well against the folly of allowing even a repetition of failures to engender despair, and more especially to bear in mind that in creation there is no object, however apparently lowly or insignificant, but what may afford us important and useful lessons by observation, and as even from poisons the bee is said to extract a sweet, so may "*the poor beetle that we tread upon*," by the simple workings of its blind instinct, suggest the most valuable elements of thought and knowledge to the comprehensive and all-sympathyzing eye of genius, which, after all, is the only true philosopher's stone—the "*heavenly alchemy*" that transmutes by a touch all baser substances into gold. It would be as well, in this place, that we should endeavour to answer what we are well aware is with many a deeply-rooted conviction of the incompatibility of genius with the strict pursuit of scientific objects,‡

* From the comparison of a number of experiments, Mr. Hodgkinson was induced to adopt a certain form in the casting of iron beams, as being the strongest and least expensive. Now, curiously enough, it is observed that this particular principle is but the adaptation of what was already universal in all natural constructions.—*See Professor Moseley's Illustrations of Mechanics.*

† The use of the diving bell is not confined to man. There is a species of spider (*argyroneta aquatica*), which is amphibious, whose subaqueous habitation is constructed upon principles strictly analogous.

‡ A philosopher of the first eminence, Dr. Reid, has given to this prejudice the sanction of his authority, remarking, "that it is genius, and not the want of it,

conceiving it to be something in its nature perverse and extravagant, tending rather to erroneous and distorted conclusion than the clear evolvement of facts, but this, we imagine, arises from a misapprehension of the proper nature of genius, and a confounding of that which is false with the true; for had it not been existent in a Galileo, a Kepler, or a Newton, would the world, we would ask, have ever been enlightened by their splendid discoveries? Believe us, genius is as strictly the handmaid of the severer sciences as of poetry and the more imaginative arts; only in the one case the charlatan is sooner stript of his pretensions, and the exposure of so many noisy pretenders has unhappily at last induced us to doubt the existence of real claimants.

Sir Isaac Newton, when congratulated by his friends upon the extent and greatness of his discoveries, replied, "I know not what the world will think of my labours, but to myself it seems that I have been but as a child playing on the shore, now finding some brighter pebble, now some more variegated shell, *while the vast ocean of truth lay unexplored before me.*" A sentiment not only beautiful for the profound fact it inculcates, but likewise for that rare deprecating self-denial of its own claims, the most certain index, we may be assured, of genuine merit; for *true genius* and modesty are inseparable from each other. If we were asked for a definition of what constitutes *scientific genius*, we perhaps should say that it consists in that subtle intellectual perspicacity which seems to behold, at a glance, the intimate relations of causes and effects, and traces from the simplest fact as by intuition the progress of a proposition through all its sinuous bearings to the one grand ultimate truth. Thus Galileo, from the swinging of a lamp at Pisa, established the remarkable isochronous property of the pendulum; and Newton, from the fall of an apple in a garden, the wondrous and universal law of gravitation. In other words, it is the faculty of generalizing. True genius, therefore, can never err, for it and truth are the same; the one being but the expression of the other.

But we must not be misunderstood, nor allow the possibility of our younger readers' running away under the impression that all is to be attained by the simple possession of this "*gift and faculty divine*," and, like the oracle of old, they have only to sit passively down and await the god. Genius implies, as its necessary adjunct, hard work; it is one essential condition of success, and nothing thoroughly great, or of any moment, was ever yet effected without much laborious study and untiring pursuit. The most precious truths, like pearls, lie deepest, and become the prizes only of the most adventurous and persevering diver.

The mysterious dependence in *Nature* between certain conditions and results is beyond our weak powers to resolve. The province of legitimate philosophy is but to establish relations, beyond which all is vagueness and uncertainty,—for the ultimate cause must ever evade our grasp; and it is sufficient for us to know that such is without seeking to understand the wherefore. It should, moreover, be remembered that the indispensable attribute and qualification required by Nature of her disciples, is a sort of religious faith in the perfection of her wisdom, not unmixed with a distrust of his own powers.

> "To look on nature with a humble heart,
> Self-questioned where he does not understand,
> And with a superstitious eye of love."

That the above trapezoidal figure should be the best form of a propelling instrument is to us as inexplicable as the all-pervading principles of gravitation, light, heat. The singular mechanical properties inherent in the cycloid,* or the angle 54° 44'—the latter affording another curious evidence of the universality of natural laws. Thus it has been proved to be the most effective angle for the action of fluids on a plane moving at right angles to their direction, as exemplified in the sails and rudders of ships, the vanes of a mill, and the feathers on the wings of birds. It also enters the figure of the rhombus, which forms the basis of the cells of bees,† being exactly the angle most advantageous for an economical storing of their honey. Again, the boomerang, an offensive missile used by the native of Australia, which approaches in form to somewhat the character of a parabolic curve, flat on the under side, and slightly convexed on the upper, offers not only a remarkable example of the fortuitous application, by an unenlightened savage, of principles the most abstruse and recondite to the common uses of his being,—but also the property, if projected at about an angle of 55° from the vertical plane, or, which is the same thing, at 35° from the horizontal, of returning to whence it was discharged, after gyrating in a very eccentric elliptical path, of which the impellent power constitutes one of the foci. Likewise, from some recent experiments made by Mr. Hodgkinson and others, at Manchester, and detailed in the seventh report of the British Association, to determinate the resistance of solids to compression, &c., it was discovered that the angle of rupture in a column was invariably in a plane inclined at about 55° to the axis.

that adulterates science, and fills it with error and false theory." Dugald Stewart, however, has fully exposed the sophistry and untenableness of this argument.

* Between one of which (the line of swiftest descent), and the path traced by birds in their downward flight, there is every reason to believe a strong analogy exists.

† Demonstrated by Maclaurin. See Philosophical Transactions, No. 471.

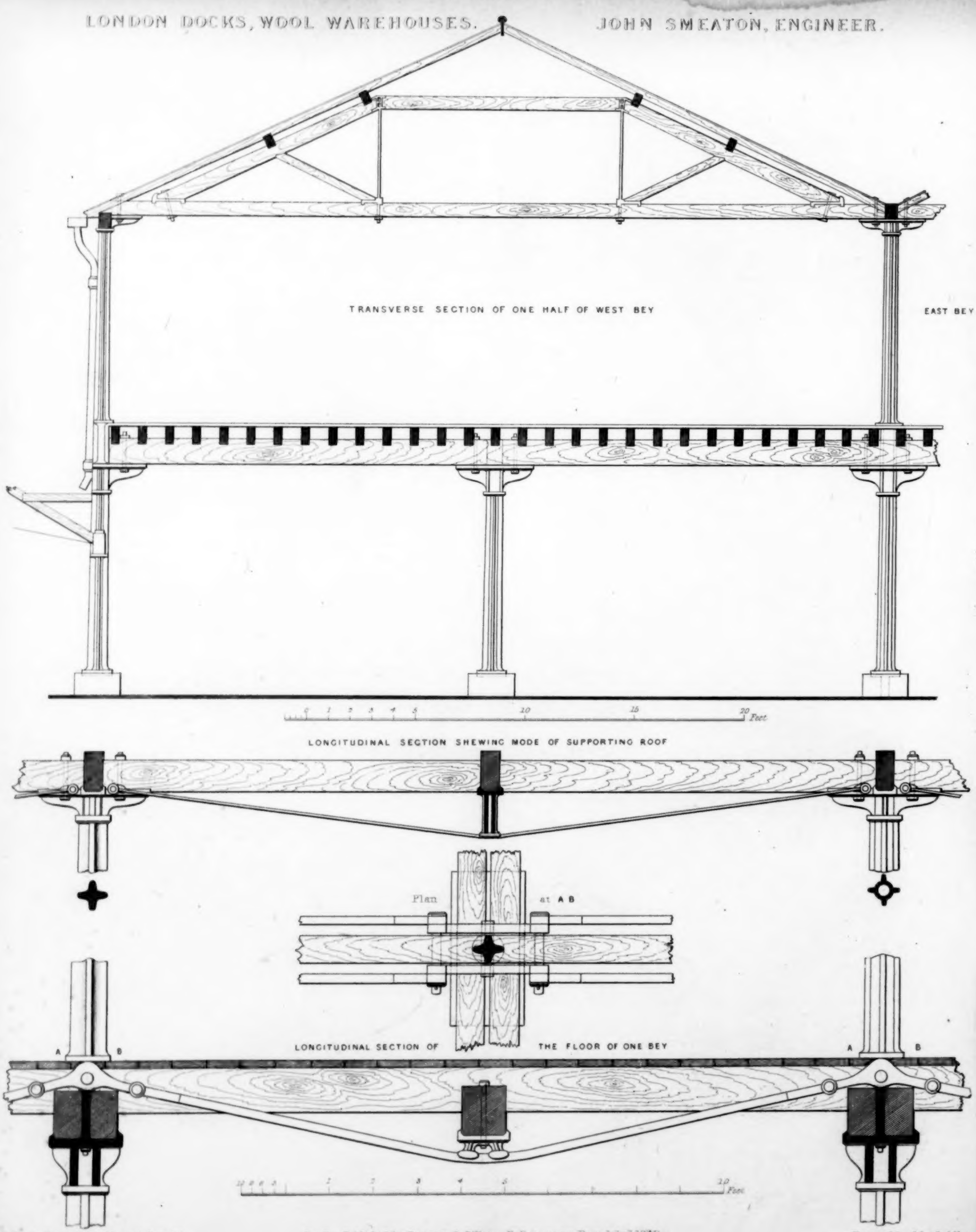
Now these incontestable proofs of the existence of a general law like the foregoing, intimate to us an invaluable principle for the improvement and construction of mechanical agents, and one which should not be lost sight of. But, it is particularly at the present moment,—upon the near completion of so many works and lines of railway, and the quick progress and projection of others, radiating from the metropolis, as from a central heart, to the most distant parts and extremities of our island, and these again intersected by branches from the principal towns and manufacturing districts, the whole promising to become, at no distant day, the most extended and complicated system of intercommunication the world ever beheld, along which, as through the arteries of the human body, the life of the nation, in its population and industry, is circulating with the same restless and untiring activity,—that the foregoing considerations become eminently of value.

And here we may notice that, although the roads and canals of a previous age did much in opening a ready access to distant localities, and affording a market and a facility for the interchange of their manufacturing and agricultural products, by which the comforts and general condition of the community became wonderfully improved, steam and railways of our own times have done infinitely more, their influence being specially and pre-eminently a *moral one*. Independent of the quick exchange of the necessaries and luxuries of existence, they conduce, above all, to the rapid dissemination of thought and sentiment; those intellectual impulses which more peculiarly tend to the civilization and spiritual advancement of the species; and, as *concentration* has been defined the chief element of power, those means which have, as it were, by instantaneous magic reduced the physical and moral energies of the country to within half their former focus, will ever be subjects of interesting investigation, and necessarily present most important considerations in the solution of the problem of human progression.

To perfect these necessarily implies the multiplication of all our resources, more especially in the mechanical and architectural arts; consequently, any, even the slightest hints, derivable from nature, must be of importance. Hence, as a partial corollary and limited application of the principles already advanced, we would, in calling attention to the numerous hydraulic works, bridges, aqueducts, piers, docks, &c., which the opening up of these vast and ramified lines of transit have, and will inevitably call into existence, destined in their durable solidity to attest, for generations to come, the wondrous revolution in the principles of our moral improvement, incidental to the present increased facilities of communication, the absence of which gave rise to those numerous evils and social anomalies adverted to in our first number. In calling attention to this, we would ask whether, among the many necessary desiderata, some cheap and efficacious cement, impermeable to water, be not one? and when nature, in the instincts of her creatures, has been to us already so infallible a directress, we probably may not greatly err by following her guidance here. Now, we believe it is generally known that the beaver, that first of all masons, whose social policy is as extraordinary as his constructive knowledge, in the building of his cabins, uses a kind of sandy earth, which is insoluble in water, and sufficiently resisting, by its adhesive powers, even the frosts and storms of an arctic winter.* So the swallows of the Nile, says Plutarch, in his book on Rivers, collect a material, when the waters recede, which is likewise as impervious to its action. In India, also, the same bird gathers a glutinous substance for this purpose, whose nest is esculent, and esteemed a delicacy among eastern epicures. But the wisdom and architectural labours of the ant are proverbial, and its intelligent foresight provides a security against the vast periodical accumulations of water in those countries of which it is an inhabitant, for, according to Sir Woodbine Parish, "in the swampy regions of *Xardyes*, in *La Plata*, where the inundations of the Paraguay

* The true mathematical proportion upon which the dam of this animal is calculated to support the greatest possible pressure of the water is likewise worthy of attention.

LONDON DOCKS, WOOL WAREHOUSES. JOHN SMEATON, ENGINEER.



Drawn by [illegible]

London Published by Grattan & Gilbert 51 Paternoster Row July 1 1840.

Engraved by John Saddler.

commences, the ants, which are in vast numbers there, have the sagacity to build their nests in the tops of the trees, far out of the reach of the waters, and these nests are made of a kind of adhesive clay, so hard that no cement can be more durable or impervious to the weather." Nature is not unmindful of even her weakest children, and, as no bane is without its antidote, so, if for the carrying out of her inscrutable purposes, some temporary evil should accrue, we always at the same time behold a wise and bountiful provision for the need. The above is also confirmed by the Jesuit Dobrishoffer, in his history of the Abipones, who says that the ants of Paraguay build their hills of so excellent and hard a material that the Spaniards hollow them out for ovens, or, reduced to a powder, and mixed with water, serves admirably for the floors and walls of houses. Might not, then, an analization of this earth afford us the secret of some more efficient and economical hydraulic cement to any we at present possess? "*Go to the ant, study her ways, and be wise,*" was the injunction of the wisest and most philosophical of men, and who, be it remembered, was, at the same time, the greatest and most accomplished of architects.

Our space will not permit us to dwell longer upon this interesting theme: the inquiry is fraught with instruction, and corroborative evidence might be adduced almost *ad infinitum* of the analogies of nature and art. Our object is but to indicate the richness of the mine. But this much we may be allowed to remark, in the progress of science and art, each day creates so many fresh calls upon the inventive faculties of mankind, and in the present age invention appears to multiply invention in a far higher rate of progression than any of which we are aware; that to meet the exigencies of the occasion, it behoves us not to neglect one of the means nature has laid within our reach. She offers to us inexhaustible subjects of thought and inquiry; each successive step but opens newer and more fertile regions of wonder, and, here at least, we need be under no apprehension of sighing, with the ambitious Prince of Macedon, for other worlds to conquer. The field of her philosophy is wide and illimitable, and, like Jacob's vision, discovers to us a ladder whose top reaches up to the footstool of the "throne of God."

G. H.

NEW WAREHOUSES OF THE LONDON DOCKS.

WITH AN ENGRAVING.

It was our intention to begin a series of articles on the subject of Port accommodation and architecture, with some account of the vast, and as those who are not acquainted with it will think, the incredible quantity of property of the most valuable description, which, though continually coming and going, is upon the average of time contained in the metropolitan docks and warehouses of the British empire, and especially in that of the London Dock Company. In one single department of those docks, namely, the tobacco warehouses, it is no uncommon occurrence to find three million sterling in value at one and the same time. Of these matters we shall, however, speak another time, as we have only space briefly to notice the subject of the illustration to this number, which we look upon as containing some very important improvements in this department of architecture.

This drawing refers to the trussing of the straining beams, and also every alternate girder of the floors, by means of rods and malleable iron, which act as ties on the under side of the beam or girder, at the same time that that beam or girder is strained by the weight, often a very great weight, upon the floor, and thus the iron rods give it more effectual support, and render it absolutely stronger than it could be made by any other means, which would allow the same accommodation, and freedom of action in the floor below.

These improvements, which we believe were entirely designed by Mr. John Smeaton, the engineer to the Dock Company, apply to a certain portion of the warehousing ground of the Dock, called the Crescent, which lies to the left, and upon getting into the Docks, by the main entrance. Mr. Cubitt is the contractor for these works; and this is sufficient guarantee that the execution will be in no way unworthy of the design. Mr. Cubitt will not overload his work by unnecessary materials, which give apparent strength, but real weakness; and there is no question that he will work out the design in a most effectual manner.

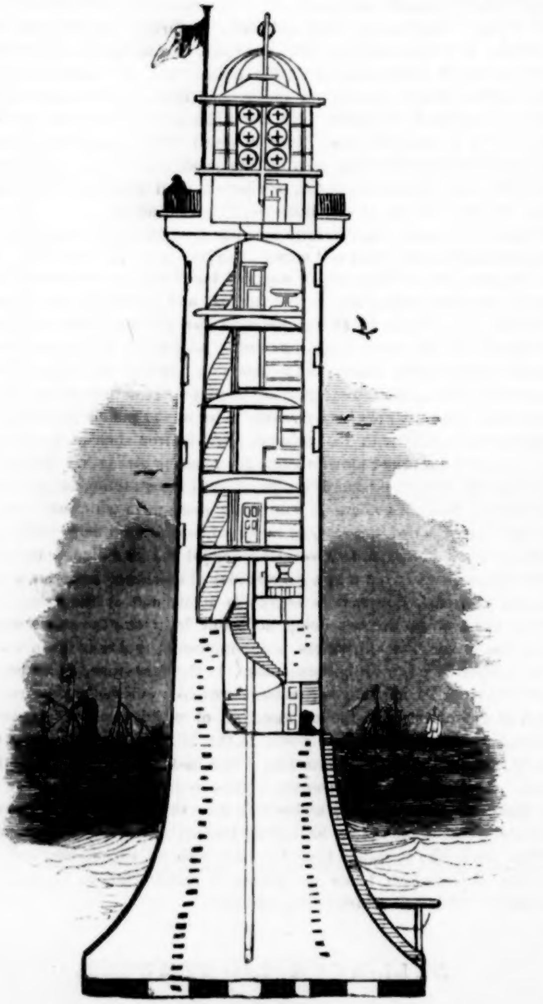
These new warehouses are four in number, two of which have been completed, and the remaining two are in rapid progress; and although these form but a small fraction of the entire warehouse room within the dock walls, yet the extent is well calculated to startle those who are not conversant with such matters. No. 1, or that nearest the gate, contains on the ground floor an area of 22,800 square feet, and on the upper floor 19,800. No. 2 contains on the ground floor 22,600 square feet, and on the upper floor 19,000. No. 3 has the same area on the ground floor as No. 1, and the upper floor contains 19,400 square feet; and No. 4 also contains the same area on the ground-floor, and 18,900 on the upper floor. Summing these, we have a total area, in warehouse room, of 168,100 feet, or very little less than four acres.

These warehouses stand directly over the crescent wine-vaults, which are constructed with pillars and arches; the pillars being 18 feet asunder, and the cast-iron columns which support the floors are so placed that there is one over each pillar of the arches, and none anywhere else. This required a length of 18 feet between the columns which support the floors; and as this was too much of a joisting for warehouse floors intended to be heavily loaded, the trusses with iron bars were introduced. As may be seen in the lower figure in the plate, those bars are bolted to connecting pieces, which have circular holes at the middle for receiving trunnions cast solid with the columns; and an iron shoe at the centre gives the iron bars the requisite angle for insuring strength. The other figure shows a cross section of the junction of the straining beams, rods, and column; and that above it shows the manner in which strength is given to the girder of the roof, by means of similar iron bars. The uppermost figure shows a transverse section of the two floors, together with the roof; and from that a general idea of these very superior works may be formed. The roof is especially light, and at the same time strong and firm, all the ties being malleable iron, and the struts wood, by which means both substances are employed in that manner in which their properties are most advantageous. In the meantime, however, we shall not enter farther into particulars—we invite our readers, especially such as are interested in the construction of warehouses and granaries to study the sketches we have given, in the full assurance that they will profit not a little by the information which these are calculated to furnish. This is the more necessary, inasmuch as few departments of the profession are less perfectly understood than the architecture of warehouses whose floors are to be heavily loaded; for in this, as in many other cases, the architect loads his work with an unnecessary quantity of materials, which tends to weaken it rather than to increase its strength. We shall return to this subject.

BELL-ROCK LIGHTHOUSE.

WITH A SECTIONAL ENGRAVING.

This lighthouse, one of the finest structures of the kind that ever was erected, and one which will be long monumental of the talents of the late Mr. Rennie, its engineer-in-chief, and to the masonic skill of—alas!—also the late Mr. David Logan, who was the operative superintendent, has been of incalculable service to vessels navigating the east coast of Scotland, and also to those which are driven northward by violent south-easterly gales on the English coast. It is situated in a part of the sea where, though the waters are not so turbulent as around the far-famed rocks of Eddystone lighthouse, which support one of the memorials of the transcendent genius of Smeaton, is yet in a situation of equal, if not greater, peril to the mariner. The Bell-rock, or the Inch Cape rock, which last is its appropriate name, is situated in the inbend of the Scottish shore, between St. Abb's Head, the termination of the Lammermuir hills on the south, and the Red Head, which may be considered as the termination of the Seidlow ridge, on the north. It consists of the same rocks of which those headlands are mainly composed, namely, a red sand stone, the same which, with various interruptions, extends from the Lammermuir ridge to the foot of the Grampians. The rock is about thirteen miles from the Red Head, thirty from St. Abb's Head, and eleven or twelve from the nearest land, which is probably the great sandy *dune*



formed by the eddy of the wind at the angle where the Frith of Tay opens westward from the inbend of the coast. At high water, the entire reef is covered to a considerable depth; and at low water, at neap tides, the highest point of it is scarcely visible; though, at low water at spring tides, about 430 feet in length, by 230 in breadth, are visible. The entire reef is about 1,000 feet long, and drops in the direction of its length toward the south-west. The proximate shore from the Tay to Arbroath, and indeed much farther to the northward, is a highly dangerous one, consisting of sandy beach, of shingle, and of ugly ridges of rock, over and against which the surf beats with great fury during south-east winds. The entrance of the Tay is also interrupted by banks. The Carr rocks form a dangerous reef off the east point of Fife; and there are formidable sandy beaches, and other perils of the shore, to the southward of the Frith of Forth.

The Bell-rock is thus in the middle of a sea of perils; and before the erection of the lighthouse, it was itself the most deadly peril of the whole, not only in consequence of the number of vessels which were annually destroyed on it, with all their crews, but in consequence of the number that ran on shore in their attempts to escape from it, before the erection of the lighthouse; indeed, the sands on the eastern sides of the dune of Barrie, already alluded to, bore some resemblance to the remains of a submerged forest, from the accumulation of the timbers of a number of wrecked vessels, the lower parts of the wrecks of which are now engulphed in the sand since the lighthouse was diminished, which is a proof of the value of the structure. Though there is not such a turmoil on the water on this reef as there is among the more abrupt points at Eddystone, yet the waves break upon it with great violence; and from the heights, at full twenty miles distance, we have seen it enveloped in one mass of white foam, while the sea around it preserved its natural colour.

It is reported that, as early as the fourteenth century, this rock had attracted the commiseration of the very wealthy abbot of the great abby of St. Thomas, at Arbroath, and that he had caused a bell to be erected, so contrived as to be rung by the waters, for the joint purposes of warning seamen of their danger, and rebuking the spirits of the waters, who, like all other malignant spirits, were at that time supposed to be much terrified at the ringing of consecrated bells. This notion of giving a settler to the spirits which trouble the waters by dint of tintinnabular sonance, is not confined to European superstition, for the Chinese practise the same kind of exorcism upon the spirits which are supposed to trouble the waters at the fall or rapid of the river, at Canton. But be that as it may, the abbot of St. Thomas had a nobler object in the erection of the Inch Cape bell; and this bell is reported to have been a means of safety for many years, until upon one fine spring morning, it tempted the cupidity of a sea solicitor, as Byron says, who met with his reward in being engulphed with all his crew, the very next time he passed the scene of his sacrilegious and cruel theft. This story may not be philosophically true in the abstract, but it is true, to all who believe it; and this we suppose is the kind of truth most current in the world.

The tidal part of the rock is abundantly covered with various *fuci*, or sea weeds, some of which grow luxuriantly, and to a great size. There are also various descriptions of shelled mollusca, and other marine animals, with numerous fishes, especially rock cod, of small size but excellent quality. When the rock was first visited, there were many muscles, and we believe, oysters, upon it; but the large white whilk, which is a more littoral animal, was imported with some of the building materials, and greatly thinned the numbers of these more valuable mollusca.

After many complaints of the want of a lighthouse, and especially after the violent storm in 1799, during which many ships were driven from their moorings in Yarmouth Roads, and even the Downs, and so many of them destroyed on the Scotch coast that, when the storm subsided, all the bays were margined by broken timber, it was at last resolved to construct a lighthouse. A bill for this purpose was passed in 1806, which enabled the commissioners of the northern lighthouses to levy three-halfpence a ton upon all British vessels trading to and from the ports between Berwick and Peterhead, and twice as much upon foreign vessels. The bill also empowered the commissioners to borrow £25,000 from government; and they had £20,000 of accumulated surplus, which showed that the provision of lights had not previously been kept up to the amount of the tax upon navigation. Still, however, this enabled the commissioners to begin the work with a fund of £45,000. While the proposal was in agitation, various projects for lighthouses were advanced by different individuals; but it was ultimately resolved, that the structure should be of stone, somewhat similar to the Eddystone lighthouse, and conducted under the principal superintendence of the late Mr. Rennie. It was well for the stability of the structure, and the benefit of trade, that this eminent and judicious engineer was appointed, for there were other parties who occasionally interfered in the progress of the work; and we have seen plans of some courses of stone, which were actually prepared in the work-yard at Arbroath, in which, from the want of central dove-tailing, and other defects, would have been very insecure, and these courses of stone were condemned by Mr. Rennie, and ordered to be broken up for rubble, as appeared by the signature of Mr. Rennie, on the plans. By the necessary condem-

nation of these faulty courses of stone, a considerable sum of money was lost, but the stability of the lighthouse was not endangered, which was the grand matter; and this shows how very careful eminent engineers who are not constantly on the spot, ought to be, in examining every working drawing of such structures as this, and allowing no drawing to be used which is not authenticated by their signature. We do not now recollect all the faults of these condemned courses; and since the death of Mr. Logan, who was in possession of the plans with Mr. Rennie's signatures, we know not where these drawings can be referred to, and reference to them is of little consequence, except as a warning; but we do remember that what struck us at the time as the grand imperfection, was the omission of the square central stone with dovetails, to which the four stones next in order were attached, and also joggled by stone in the end joints, thus making the five one complete mass of stone, to which the whole of the surrounding stones were attached. In place of this central stone, which was of course the key and fastening of the whole, there was substituted in the drawings, a plain hexagon or octagon, we forget which, by means whereof the whole bonding of the course was loosened, and had water percolated into it, it would have been destroyed by the hydrostatical pressure. An accident of this kind happened to another structure, which the engineer to the commissioners of the northern lighthouses had planned, and was in the course of erecting upon the Carr rocks, off the east point of Fife. This structure was to be furnished with a bell, to be rung by a float, and in order to contain the float, a hollow column was erected, having a lateral opening at the bottom. The column was, we believe, pretty well secured against the external action of the water, but it should seem that the danger of hydrostatical pressure from within had been overlooked, for, after the work had advanced so far as to be distinctly visible from the land, the sea, beating over it during a violent storm, had thrown in rubbish which blocked up the lower aperture, and the hollow of the column filled with water, which burst it in pieces, so that it vanished before it was finished. As this structure is gone, and has left no memorial, it would be of little consequence to inquire into any of the particulars of it; but the fact is worthy of record, as tending to show how very careful engineers should be in attending to every principle in the planning and executing marine structures; and also how careful those who direct the building of such structures ought to be in the selection of their engineers. To suffer, in any lighthouse or beacon-tower for the warning of mariners of the perils of the sea, any weak portion or point which shall endanger the stability of the structure, may be attended with more calamitous effects, at least for a time, than having no lighthouse or beacon at all; for the lighthouse or beacon gives the seaman a certain security, which prevents him from avoiding the danger so assiduously as he would do were there no lighthouse there; and, therefore, he is tempted towards the rocks, and wrecked upon them, if the lighthouse falls before his arrival. The Bell-rock lighthouse is as secure against any casualty of this kind as a structure of human erection can be; and, from what we have stated, those who navigate the dangerous coast on which it stands, cannot be too thankful that Rennie had the superintendence of the building, or hold the memory of that eminent and most judicious engineer in too high estimation.

While, however, this tribute is justly due, and ought to be paid to the memory of Mr. Rennie,—Mr. Logan, under whose care the work was more immediately executed, ought not to be forgotten. Perhaps no man was ever more capable of executing stone work to bear the violence of the sea; and, let the plan be ever so good, a work may be rendered unstable by ignorant or negligent execution. Logan had been trained from his infancy in aquatic architecture, more especially in the construction of bridges which had to resist the action of violent floods; and, therefore, though a very young man when employed in the Bell-rock Lighthouse, he well knew the nature of the work, and was most faithful in the execution of it. His execution of the Dundee harbour, under Telford, and of the packet harbours between Ireland and Scotland, under Rennie, are lasting monuments of his ability, and had he not been prematurely cut off, there is no doubt that his operations on the Clyde would have been of the greatest benefit to Glasgow, and to all who are any way connected with it. Indeed, his professional zeal may be considered as the real cause which shortened his days; for when laying the foundations of the Dundee harbour, some of which were in very deep water, he was constantly on the ground when the tide permitted, and standing in the water for hours, directing and encouraging the men, whether it was night or day, and whatever was the state of the weather. This labour and exposure, which would very soon have killed most men, brought upon him a severe and long-protracted rheumatic fever; and, though the natural strength of his constitution enabled him to survive this for a good many years, he never thoroughly recovered from it.

In enumerating those who were chiefly instrumental in making the Bell-rock Lighthouse what it is, there is another and a different character whom it would be injustice to pass over in silence. This was Watt, the machinist, or, more strictly speaking, the man of all work, or rather of all contrivance, in cases of emergency. As is but too frequently the case with workmen of great inventive talent, Watt was somewhat dissipated, and passed not a little of his time in alehouses. In this matter he was allowed to have his way, only to be always ready at a call; and when the course of the work rendered a crane, or crab, or, rather, engine of peculiar construction, necessary, Watt was sent for, and instantly sketched out — rudely enough, in some instances — the very machine which answered the purpose, and having done so, he returned to his potations. Among his contrivances we may mention two cranes, which are certainly superior to any others for laying heavy stone in difficult situations. One of these was a "jib crane," of great power, and easy management. It was supported by four gye-ropes in the usual manner, and traversed freely all round. The jib or arm was jointed to the pillar, so that it could be brought into all positions from horizontal to vertical; and, to prevent it from lapping to the pillar, when raised beyond a certain elevation, the jib-chain by which it was raised or lowered passed over a pulley in the bight, so as always to give a downward pressure on the point of the jib, where the pulley of the crane-chain was attached. It was worked by wheel and pinion, and of course required two sets of "geer," one for working the jib, and the other for working the crane. By means of these contrivances the largest stones, some of which were two tons, could be brought to any point within the range of the jib, with great certainty, and very little manual labour.

While the building was solid, and of such moderate height as that the gye-ropes could be fastened, this crane answered exceedingly well; but after the structure had advanced to some height, and especially after it began to be hollow, a crane of this description could not be so fastened as to command the whole surface and have sufficient security. Consequently, the invention of Watt had again to be called in; and he contrived his counterpoise cranes. This crane was supported on a hollow pillar of cast iron, which was lengthened by adding additional pieces as the progress of the work required. The crane, which was a platform with two equal arms, traversed upon this pillar, and was of sufficient length to command the whole work, and as much more as sufficed for raising the stones. To the one arm was attached the chain for this purpose, while the other carried a hook upon which weights could be placed to counterbalance that of the stone; and the working parts were so arranged that, when the stone required to be moved outwards or inwards to bring it to its proper bed, the weights were also moved outwards or inwards; and thus the leverage of both ends of the crane was always equal, as well as the weight. Thus it traversed freely, was easily worked, and perfectly stable. One of the barrels also raised the platform of the crane by means of a pulley and chain on the top of the pillar; and there were apertures through both sides of the pillar for supporting the platform when raised to the proper height. When the pillar itself required to be lengthened, the pulley was removed from the top of the pillar, a new piece of pillar added, the pulley replaced, and the chain lengthened, and passed over it, as before. In this way, by adding length after length, the laying of the stones by means of the counterpoise crane,

was carried on to the required height, with ease, expedition, and safety, which could not have been maintained without such an apparatus.

The lighthouse itself is a splendid structnre, of which the external contour is good, and the execution. The height of the masonry is 100 feet, and the light-room or lantern is 15 feet more. The diameter at the base is 42 feet; but at the parapet of the lantern it is only 13 feet. The first 30 feet consist of solid masonry, the lower courses let in, and tree-nailed to the rock, and all the solid courses are dove-tailed, joggled, and treenailed; and as they are laid in strong mortar, which sets readily and firmly, the whole of this 30 feet has very nearly the cohesion of one solid mass of stone.

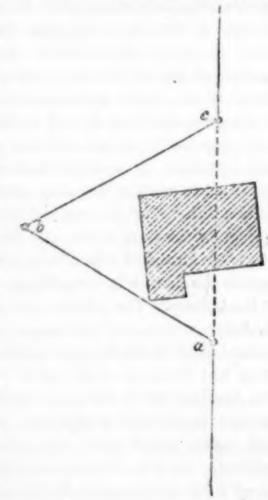
In the section the entrance and lowest apartment will be seen at the top of this solid masonry, with an external stair and platform for landing when the tide suits. The walls of this apartment are seven feet thick, it is occupied by the water tanks, fuel, and other heavy necessaries. The second, which is much more ample, in consequence of the reduced thickness of the walls, contains the oil and other stores necessary for the lights. The third floor is the kitchen, and the fourth the bed-room for the keepers; and the fifth room is the library and place for the reception of such strangers as have hardihood to visit this lonely sea-girt pillar. Over all these is the light-room, with double glazed windows, and wholly fire-proof, except the external dead lights, which are put on as occasion requires. The balcony around the light-room is well secured by a cast-iron railing, supported with brass, and having a strong top rail of that metal. The parapet of the light-room is six feet high, and from it a door opens to the balcony. The sashes of the windows are of cast-iron, the glazing strong plate double as we have said, and the dome is of copper. The lights revolve, and they are alternately a white and red light, produced by stained glass. The lights are powerful, and can readily be seen at a distance of 20 miles or more, unless when the atmosphere is foggy; and unfortunately no light has yet been discovered which can so far penetrate a thick fog as to warn a ship of danger in time for even a chance of escaping.

As the best substitute that the circumstances admit of, two bells of 12 cwt. each are tolled constantly day and night, when the atmosphere is foggy, by means of the same machinery which moves the lights. In calm weather, during which fogs are most frequent, the sound of these bells can be heard over all the surface of the rock, which is absolutely dangerous; and thus they justify the appellation of Bell-rock Lighthouse, and remind one of the Abbot of St. Thomas.

The rise of tide over the foundations of the lighthouse is about 15 feet, at ordinary spring floods; and when the sea is perfectly tranquil, the structure seems resting on the waters. Altogether, indeed, the Bell-rock Lighthouse is a structure of great interest, and one which has been the means of saving many lives and much property. Considering that the workmen had to contend with the violence of the sea, upon a rock 12 miles from the land, and with its highest point 12 feet below the surface at high water; it will be readily understood that the commencement of the work, and all the early stages of it, must have been attended with great difficulty and no small danger. A faithful history of its construction, drawn up with even the tithe of the talent which Smeaton displays in his report on Eddystone, would be an interesting and instructive work; but unfortunately there was no Smeaton conversant with all the details of the Bell-rock; and the result is, that all the published accounts of it are meagre, and some of them perhaps not true.

MEASURING INACCESSIBLE DISTANCES.

In measuring the base, or any principal lines in a survey, it is not only necessary that the exact distance through any obstruction—as a building, wood, or the like—should be accurately determined; but also the position and direction of the line on the opposite side, or at a sufficient distance beyond, as to be clear of all impediments. It will also be found of considerable advantage to have this distance of some integral length, as five or ten chains, or more as required, and it will be a preferable method to discontinue the direct measurement also at some integral length, by which means no confusion will be likely to arise in adding the distances together and continuing the measurement forward. Thus if in measuring a principal line an obstruction exists at 84 chains, stop at 80 chains, and let the unmeasured or inaccessible distance be exactly 10 chains, then it is evident that no mistake can possibly arise in the chainage, and it will be an easy matter to deduct the *back* measurement to the obstruction from the 90 chains, and the *forward* measurement from the 80 chains, to correctly opposite the object. Having said this much on the subject, we will explain what we believe to be the most easy and correct method of passing round such an obstruction, and determining the position and direction of the line on the opposite side. In the annexed diagram the line *a c* passes through a building; from *a* sett off a back angle of 120°, or a found angle of 60°, and measure at a distance of 10 or 20 chains to *b*, until clear of the obstruction. Then set off another similar angle at *b*, and measure at the same distance to *c*, at which latter point set off a back angle of 120° in the line of *a c*, which will give the forward direction of the line, which in most cases of determining inaccessible distances is rarely thought of, although often of the utmost consequence from the back objects on the line being generally hid from sight by the intervening building. By taking an angle of 60° at *c*, and reversing the instrument employed, the forward direction of the line would be obtained, although not in so accurate a manner as by taking its supplement.



CLEGG'S ATMOSPHERIC RAILWAY.

Preparations having been for some time in progress, for the public exhibition of experiments, with this proposed substitute for locomotive engines, the exhibition was announced for Thursday, the 11th of June, and the day being fine the attendance was considerable, though those who composed it had more of the holiday than the scientific character.

Our readers are perhaps already aware that this contrivance is a modification of that projected long ago by Mr. Valance, for sending the mail bags through exhausted tubes, to the places of their several destinations. Mr. Valance made his proposal before the introduction of Railways and locomotive engines, and of course there was nothing to do but insert the bag before the air-tight piston, exhaust the tube, let on the pressure of the atmosphere, and away went the bag, no one can tell how many miles an hour. Mr. Clegg has come after the construction of Railways and the use of locomotives; and his object is to avail himself of the former, but to get rid of the latter, by substituting in their stead stationary engines along the lines, or at least at those acclivities of them where the wheels of a common locomotive would *skidd* and not advance.

By using the rails for the wheels of his carriages and the tube only for propelling, Mr. Clegg has had a difficulty to contend with which must always diminish the power of his apparatus, and occasion a vast deal of wear and tear—more perhaps than in any other contrivance for obtaining mechanical power: his tube must be cleft along its whole length, to such width as shall admit of a sufficiently strong connecting bar between the train to be propelled and the piston which propels it. The strength of the tube is thus paralyzed against both the external pressure of the atmosphere upon it when exhausted, and the lateral jerks arising from inequalities in the rails. In consequence of this no valvage applied along the cleft can be made perfectly air-tight; and it must become less

and less so every day. To work an air-tight piston for any length of time, and with any considerable degree of velocity, along a cleft cast iron tube, is a practical problem of great difficulty if not absolute impossibility, at all events without a sacrifice of more than it is really worth. This is not the only objection which requires to be obviated before the contrivance can be usefully adopted by the public, or safely speculated on by shareholders in a joint stock company; but we must say something about the experiment on the day alluded to, and then add a few words on the other matters.

The experiment was tried upon half a mile of that railroad which is intended to connect the Birmingham and the Great Western Railways, and the rails not being in the very best order, the experiment was made under some disadvantage. The tube for exhaustion was laid down near Wormwood Scrubbs, where the railway has an ascent of about 22 feet in the half mile. Near the upper part of this, the exhausting air-pump, and the steam-engine which works were placed at the upper end of the half mile in a temporary building erected for that purpose. The engine is of sixteen horse power; and the air-pump 3 feet in diameter, with a shake of 22 inches, a lateral branch connecting the barrel of the pump with the tube to be exhausted. This tube had a diameter of 9 inches; and the degree of exhaustion averaged about 18 inches of mercury, or three-fifths of the common toricellian vacuum. 14·7 lbs. is the usual pressure per inch with this vacuum, under free exposure to the atmosphere, and therefore with this exposure the pressure upon each inch, (we mean square inches) of the piston would have been about 9 lbs. But after the piston has advanced even a comparatively short distance into the tube the exposure to the atmosphere is by no means free; because of the distance of the open end of the tube, and the fact of the valve upon the cleft being pressed down by an appendage to the arm which connects the arbour of the piston with the train or carriages. This pressing down is necessary, in order that the opening edge of the long valve, and the groove into which it is pressed, may be made as air-tight as possible by luting with the mixture of oil and wax with which they are abundantly smeared. Without this it would be impossible to exhaust the tube a second time; because the air would make its way through the imperfect closing of so long a valve, as fast as it were drawn out by the pump. Even with it there is a very great deal of leakage; for we could hear the air hissing in to the tubes as we walked along during the process of exhausting.

Thus, though the exhaustion of the air exhibited nearly the same pressure on the square inch as that of steam working with the pressure of the atmosphere, yet the estimate for the steam-engine is, after deducting all the loss by friction or otherwise, in its own working, while the friction of the air tube and its piston, together with the imperfect effect with which the air follows it, have to be deducted from the exhaustion shown in Mr. Clegg's apparatus. There are as yet no data upon which these can be estimated; but from the quantity of abraded iron mixed with the smearing upon the piston and inner surface of the cylinder it is evident that the friction, and consequently the wear, of these parts must be very considerable. We are just as much at a loss for data upon which to estimate the deficiency of pressure behind the piston, from the difficulty which the air meets in entering the long and narrow tube; but this also must be considerable; because, although the force of the air which the cylinder drives before it after passing the connection with the air-pump, forces open the upper valve; yet air continues to rush into the tube at this end for some time after the engine has cleared it, proving that the air which has pressed immediately upon the piston during its progress, has been very considerably rarer than that of the free atmosphere. As we have said, there are no data, upon which the loss from these causes can be calculated; but as the loss on the steam-engine is about one-half, two-thirds is too low an estimate for it here. Call it two-thirds however; and we have a sixteen-horse power engine employed, to procure an atmospheric pressure of 3 lbs. per inch, upon a piston 9 inches in diameter. In round numbers, the area of this piston is about 63 inches; and the total pressure on it is 189, say 190 lbs. of effective power. Thus, the loss of power is enormous; for if we allow the traction per ton weight to be 9½ lbs., the total effective duty of the sixteen-horse engine is to propel a train of only twenty tons, and that only over half a mile of road.

In the experiments, the two carriages with their loads, weighed about 9½ tons; and as they were propelled by the whole effective force of the apparatus they must have shown its entire power. This power was efficient to the propelling of the 9½ tons at an average rate of ten miles in the hour; and, of course, for greater speed than this the load would have to be diminished.

We could have wished to see an experiment with the piston propelled along by the whole power as before, but carrying nothing save its arbour, and the arm or bar which connects the carriages to it; and then we should have liked to see the weight brought up, by adding successively a ton or some multiple of a ton, until the piston had been brought to a perfect stand-still at the lower end of the tube,—as by this means we would have had a series expressing the ratios of the weights and velocities.

We have no wish to give an unfavourable opinion, or circulate an unfavourable impression respecting any project in the engineering arts; but our duty to the public, as well as to the parties themselves, renders it necessary that we should speak the truth. We would wish to be tender, even in cases of failure; for as all engineering discovery is matter of trial and error, there must necessarily be many failures before that which is most advantageous is arrived at. For this reason, he who fails, where the principles are fair for success, should be encouraged rather than censured, though it is for his own advantage that the errors of principle upon which he proceeds should be pointed out. In addition to this there is at the present time another reason for scrutiny. Invention has become somewhat mercenary; and very many of the results of this invention are, like the Jew's razors "made to sell," not made for use, though in some instances they *do* "shave."

TO THE EDITOR.

FLOATING BRICKS.

SIR,—In reply to "An Engineer," I beg to state that I have chemically combined the various elements which he states compose "mountain meal," and I find that when made into bricks it answers every purpose. I have also taken their specific gravity, which I find to be greater, and not as an Engineer says, "less than that of water." Still they float on the surface of water, which is owing to their porous nature, as is the case with pumice stone, which floats, although its specific gravity is greater than water. I have heard also that the mountain meal of Cornwall is entirely different in chemical composition to that which Fabbroni analyzed.—I am Sir, yours very obediently. "JUVENIS."

London, 31st May, 1840.

TO THE EDITOR.

SIR,—I should feel very greatly obliged, if you, or some of your numerous correspondents would give me some information on the following points:—

1st. Is there any really good practical work on Land Surveying, in either the French or English language, and if so, what is the title of it.

2d. To what degree of accuracy can the Prismatic Compass be made to determine angles?

3rd. What is the best mode of laying down angles on paper?

I am of opinion that any one who would turn his attention to the simplifying and reducing the expense of the various instruments used by the surveyor, would be doing a very great service to most members of that profession. I have heard the present high price of a land sur-

veyor's *stock in trade*, alleged as an advantage, on the ground that it has a tendency to limit in some degree the number engaged in that business; but this circumstance, if it operate at all as a barrier, will only do so to the prejudice of those who from deficiency of pecuniary means are really the most in need of a business to support them.—I am Sir, your most obedient servant, TYRO.

TO THE EDITOR.

SIR,—Your correspondent, "A Surveyor," gives the following reasons why the parish plans, prepared for the Tithe Commissioners, have failed in the examination to which they have been submitted, viz., "the endeavouring to get them done at so low a rate that it is not worth the attention of any educated and competent surveyor," and then adds "the consequence is, that they fall into the hands of persons who are not qualified for making the surveys with the requisite accuracy." Now, these are reasons, I think, no person will question, but I would ask why have not the *influential gentlemen* of this accomplished profession, provided a remedy for this existing evil, by founding a SCHOOL OF EXAMINATION, and prohibiting all persons from practising as a *surveyor*, who have not gone through the *requisite examination?* If that were done, I think, we should have no cause to complain that "the parish surveys of England are a disgrace to the parties themselves, and a stain on the profession generally."—I am, sir, yours respectfully,

Birmingham, June 6th, 1840. AN INQUIRER.

TO THE EDITOR.

SIR,—I beg to direct your attention to the present practice of sloping the sides of ground cuttings upon the lines of railways. The effects of the practice which is now adopted are visibly defective, as well as being attended by evils injurious to the supporters of railway undertakings. Railways, from inherent causes, require an outlay of much capital; it is, therefore, on that account, most desirable that every expenditure, beyond what is required for the absolute perfection of the work, should be avoided. The present practice of sloping the sides, in excavations for railways, is to give to them slopes of an *uniform ratio*, The ratios are generally influenced by the description of earth to be excavated; and, in some cases, the angles of the strata are considered, and the slopes in obedience to them farther guided in their proportions.

Such I believe constitutes the present practice, and if the pressure upon the sides of the excavated parts *were uniform*, an unvaried ratio for the slopes would be an adequate protection for their stability. Common observation, and the numerous cases to which it is attracted, renders it almost needless to demonstrate that the pressure to which we allude *is not uniform*. We must admit, therefore, that the pressure varies, for, as there is no spontaneous influence to affect material substances, beyond the power of gravitation, the pressure must vary according as there is more or less superincumbent material. The pressure is, therefore, greatest at the bottom of the slope, and decreases by the influence we have described, until it arrives at the surface, where the pressure consequently ceases. The inference to be deduced is, that the slopes should be, in the place of being uniform throughout, varied as the pressure varies—that action and counteraction should be equal. That the sides of the slopes be formed so that they may, as they ascend, increase in the angles which they make with the horizon.

I am, sir, yours respectfully,

June 8th, 1840. E. J.

TO THE EDITOR.

SIR,—In the March number of your Journal I observed some observations on the construction of chimneys.—I have often been surprised how the use of chimney pots got introduced into this or any other country. I consider them perfectly useless articles. Perhaps if I draw the attention of your readers to the form of the tin horn that is used by the guards of the mail coaches, the principle of chimneys will be better understood, and if builders will only try the experiment they will be fully convinced. If the large end of the horn be placed downward over some ignited bituminous matter, we shall find only part of the smoke will ascend, but if we place the small end down, we shall not only find the draft greatly increased, but the smoke will ascend freely up the tube.

This hint will, no doubt, be sufficient, and I am, sir, your obedient servant,

Brixton Road, 24th June, 1840. J. R. B., C. E.

THE ARCHITECTURAL SOCIETY.

ON June 2nd the last conversazione for this session was held at the chambers of the institution, No. 35, Lincoln's-inn-fields. The meeting was one of the most crowded description which we have witnessed here; and amongst the members and visiters present were—the Earl de Grey, president of the Institute of Architects, and several distinguished members of that society; also the Dean of Hereford, Count Rosen, the Honourable Colonel Fox, Honourable Colonel Grey, J. Walker, Esq., president of the Society of Civil Engineers; W. Pickersgill, Esq., R.A.; Dr. Roget, Rev. J. Hunter, Captain Parlby, David Pollock, Esq., &c.

Mr. Grellier read the report of their last year's proceedings up to the present period, from which it appears that the society has increased considerably in numbers, and that their funds are amply sufficient for all the purposes of the institution; and that the attendance of members and students at their lectures was also much greater than it has been heretofore. It then enumerated the various courses of lectures given, either by professors in the various arts and sciences, or by the members, all of whom were mentioned. It regretted that the students had not taken all the advantages they might have derived from the great sources of information possessed by the society, solely for the use of its members; but that those who had assiduously devoted their time to those studies had shown themselves worthy of the rewards bestowed upon them. It then mentioned the donations of works in literature and art, presented to the society by various members—namely, Owen Jones, Esq., the Alhambra; J. Britton, the Chronology of British Architecture, &c. It then remarked on the prosperous state of society, and closed with a resolution of thanks to W. Tite, Esq., their president, for his zeal in promoting the interest of this society.

The President then addressed the meeting, and gave a discourse on that class of public buildings by us denominated "Exchanges;" but which generally, on the Continent, are called *Les Bourses*. He gave a detailed explanation of the causes that led to the adoption of this class of buildings, and in doing so went back to ancient Tyre and other oriental cities where commerce flourished, and where such places of resort were built as in Europe afterwards, for the common convenience of those engaged in commercial intercourse. Those of Greece and Rome were next described, the former being a plain open space, the latter divided into two parts; and he observed that the Roman Fora had much resemblance to the modern exchanges. They were of an oblong form, those of the Greeks were square, and they were at that early time places of assembly for merchants, of whom there was a college in Rome associated in the Temple of Mercury. The Rialto in Venice was not the place of exchange, but it led to the first island that was inhabited, in which was St. James's church, and before the church was the place of exchange. In the Netherlands a bourse was erected at Bruges in 1531, and those of Antwerp and Amsterdam were afterwards erected. From these the French borrowed their ideas, and adopted them at Rouen and other commercial cities. It was not until 1566 that the first stone was laid of the first Gresham Exchange, which appears to have been in a great measure copied from that of Antwerp; and in 1571, Queen Elizabeth in person conferred on it the name of Royal Exchange; and its plan was adopted in that of Amsterdam, A.D. 1608. The old Gresham Exchange was burned down in 1666, and the late one was erected by Edward Jarman, not by Sir C. Wren, as is commonly reported. The exchanges of Paris, St. Petersburg, Dublin, and Glasgow, are covered in, but that of Liverpool has an open area of large dimensions.

After this discourse the president proceeded to deliver the rewards to the successful candidates as follows:—

1. To Mr. Horace Jones, for an original design of a concert-room—a pair of silver compasses.
2. To Mr. William Padmore, for the best measured drawings of the Burlington-house Colonnade—Sir W. Chambers's Architecture.

3. To Mr. Arthur John Green, for the best abridgment and notices of the lectures delivered—The fifth vol. of Britton's Antiquities.

4. To W. Padmore, for the best sketches of designs of buildings—The Antiquities of Athens.

When the premiums were distributed, the president pointed out to the meeting a number of valuable and very interesting works placed in the rooms, several of which were sent by friends of the society, for which thanks were returned. This closed the session, and the company then took refreshments and kept up the conversational amusements until past eleven o'clock, when they all retired.

REVIEWS.

"WINDSOR CASTLE:" ILLUSTRATED BY THE LATE SIR JEFFRY WYATVILLE, R.A., F.R.S., ETC. DEDICATED TO THE QUEEN.—JOHN WEALE, LONDON.

Of this splendid and truly national work a specimen plate now lies before us, consisting of a general perspective view, so as to represent all the leading towers, and the unrivalled oriel windows of the grand royal apartments. Sir Jeffry Wyatville received orders from William IV., and in 1834 began the work; and when the nation had to mourn the demise of that patriotic monarch, and our present noble spirited Queen succeeded to the throne, she expressed her entire approval, and Sir Jeffry proceeded with the work, which was almost on the eve of publication when the world was deprived of his talents. It is, however, to be brought out under the auspices of the son-in-law and the executors of Sir Jeffry, edited by Henry Ashton, Esq., and published by Mr. Weale, whose spirit and discrimination as an architectural publisher are well known.

Though the engravings are perfectly authentic, exquisite as specimens of art, and will, in all, amount to forty, the work will be cheap as well as excellent. To architects it will be a professional treasure; to every lover of our country and its institutions, it will be a gem; and we doubt not that it will be in great demand abroad. It will be this and all these, for various reasons. In the first place, Windsor Castle, in its situation, its plan, and its execution, is scarcely equalled by any palace. There are many which are more gaudy; but there is none which stands on the hill top with such chastened yet such sublime majesty; nor is there, perhaps, any which commands the view of so extensive and at the same time so varied a country. In the second place, Windsor Castle is not a mere palace, it is a monument—and a proud monument, of a long period of English history; and it is worthy of remark that the grand state apartments overlook the sacred expanse of Runnymede, and hus the monarch is daily reminded, though the reminiscence is not necessary in these our times, that, if the people of England have not their just rights and liberties conceded to them by the free will of their rulers, they will win them in like manner as Magna Charta was won from King John at Runnymede.

"RICAUTI'S RUSTIC ARCHITECTURE." PART II.

This part contains the basement plan, back and front elevations, and sectional views, crossing each other, with a fine perspective view, of a forester's cottage, designed for a small private family. Also, we have the plan and elevations of windows and chimneys with great clearness and taste, with scales of height and measurement. The total estimate for the whole not exceeding £220. Indeed, these plates do the artist great credit—the perspective view especially, embracing, it appears to us, elegance, convenience, comfort, and cheapness. There is one slight omission, however; the outer fence strikes us as being somewhat too slight for requisite protection against depredators of all kinds, which should be provided for, as insecurity is, perhaps, the only thing to be advanced against all the other attractions of a sylvan life. We shall anxiously look for the forthcoming parts.

RECORD OF PUBLIC WORKS.

Glasgow and Greenock Railway.—This undertaking is progressing with great speed by night as well as day. The arches at Port Glasgow are being rapidly executed. Such is the progress made throughout, that the line will be very shortly completed, at least so as to allow of the transmission of goods and passengers.

Birmingham and Gloucester Railway.—A portion of this line, about seven miles, will be shortly opened for traffic, and it is calculated that it will be entirely completed by the end of the present year, and opened to the public.

Great Western Railway.—This railway is now opened to Steventon, a distance of 52 miles, and there is every probability of the line between Bath and Bristol being completed by the month of September. The elliptic Gothic-arched bridge across the Avon is completed, and presents a splendid appearance.

Bristol and Exeter Railway.—It is expected that a portion of this line, as far as Bridgewater, will be opened in the course of the present year. We are glad to hear that the cutting of the only tunnel on this line has proved much more favourable than was expected. By a headway cut through for the purpose of draining, it is discovered that the roof of the tunnel is one continuous mass of mountain limestone throughout, without rent or fissure; so that there will be no occasion for masonry, the limestone being fully sufficient for supporting its own, as well as the superincumbent materiel.

South Eastern Railway. The works in the neighbourhood of Tunbridge are proceeding with increased activity. The Penshurst cutting is carried on at a greater rate than has yet been attained by any other railway in England, in order to open the line to Tunbridge in the shortest possible time. The quantity moved daily from one end to the Medway embankment exceeds 1,000 cubic yards.

Manchester and Leeds Railway.—The viaduct at Todmorden on this line is now finished, having been little more than fifteen months erecting. It consists of nine arches, seven of which are of 60 feet span each, and two of 30 feet; and the height from the turnpike road to the level of the rails is 54 feet. The viaduct is built of the best stone, which is found in the immediate neighbourhood.

Great North of England Railway.—The iron bridge over which this line will pass, a little to the south of Northallerton, and which crosses the old post road from Boroughbridge near the 220th mile stone from London, is now finished. It is the greatest span of any iron bridge on the flat principle.

Manchester and Sheffield Railway.—We understand that the works on this line are proceeding with great spirit, and that the financial affairs of the company are daily improving.

Slamannan Railway.—This railway is expected to be opened shortly. Arrangements have been made for establishing a passenger trade between Edinburgh and Glasgow by the Slamannan railway, the Union canal, the Ballochney, the Menkland and Kirkintillock, and the Glasgow and Garnkirk railways.

Llanelly Railway.—We understand that the expenses of this railway will come to several thousand pounds under the estimate. Mr. Biddulph is the engineer, and as an event like this is of so very rare occurrence, on this occasion it ought not to be passed over; and Mr. B. ought to be pointed out as an example for others to imitate. This line seems to be one of the fortunate; it has a secretary who does the work of two or three men, and an engineer who keeps within his estimate.

Maryport and Carlisle Railway.—The opening of this line which was expected to take place on the 12th ultimo, is now definitely fixed for the 15th instant.

North Midland Railway.—This great line, which is to connect Leeds and the heart of Yorkshire with London, Birmingham, and the West of England, will soon be in full operation, and diminish the distance between Leeds and London to one-third the time usually expended on the journey.

MISCELLANEOUS.

The Trafalgar.—The interest which vessels of the magnitude of the Trafalgar, at present building in Woolwich dock-yard, excite in the minds of the public is such, that a correct account of her dimensions might prove acceptable:—Length of gun deck, 205 feet 6 inches; keel for tonnage, 170 feet 6 inches; breadth extreme, 54 feet 7 inches; breadth moulded, 53 feet 9 inches; depth of hold, 23 feet 2 inches; burden, 2,702 tons. She will be launched in February, 1841.

Mail Conveyance.—The Bath, Bristol, Oxford, and Cheltenham mails are now conveyed as far as Steventon by the Great Western line. Hitherto they have been transferred to horse coaches at Reading. As soon as the necessary arrangements can be made for the acceleration of the night mails to Hull by railway, a day mail will be extended to that important town.

The "Iron Duke."—This vessel lately launched is the first iron ship built on the Clyde. For model and symmetry it may vie with any vessel built on the Clyde. The figure-head is a full length of the Duke of Wellington, in his field-marshal's uniform, and is a good likeness. The following are the dimensions:—Length, 103 feet; breadth of beam, 27 feet; depth of hold, 16 feet; register tonnage, 390; burden from 600 to 700 tons. The iron duke is intended for the East India trade.

Harbour of Refuge.—We understand that Pevensey, in Sussex, has been fixed on by the Naval Commission for a harbour of refuge for the southern coast.

Metropolitan Patent Wood Pavement.—The principle of this kind of wood pavement is getting into considerable public estimation. The piece laid down in Whitehall has been reported on as highly satisfactory; and the 2,000 yards laid down in Oxford Street have been so much approved, that an equal quantity more has been contracted for, and is in the course of construction. The principle appears also to be taking root in other parts of England.

Scientific Institutions.—The sums annually received by the several institutions in London for promoting science and art are not less than £100,000. Their funded property is about the same sum, and the number of volumes in their libraries 100,000.

The Railway to Scotland.—The report of the commissioners, appointed by government to report upon the relative merits of the different railway lines projected to connect England and Scotland, is adverse to our hopes, and we refer to its details with sadness and indignation. The commissioners proceed, in their report, more like special pleaders, against the Morecombe Bay line, than as impartial judges weighing the evidence in a case where mighty interests are involved.—*Whitehaven Herald.*

Preserving Timber from Decay.—A discovery by Dr. Bourguet, for dyeing and preserving timber, was lately discussed in the French Academy of Sciences. Dr. B. states, that if the lower part of the trunk of a tree be immersed, as soon as it is felled, in a preparation of pyroligneous acid, the preparation will be absorbed throughout the whole of the tree, and that the timber will subsequently resist decay. He states also, that if colouring matter be placed in the liquid, it will be carried through all the vessels of the tree, even to the leaves, and be permanently fixed.

LIST OF PATENTS.

Continued from page 120.

(SIX MONTHS FOR ENROLMENT.)

Henry Augustus Taylor, of New York, now of Milk-street, Cheapside, merchant, for "improvements in the manufacture of braid and plats," being a communication.—Sealed May 28.

Alexander Francis Campbell, of Great Plumstead, Norfolk, esq., and Charles White, of the city of Norwich, mechanic, for "improvements in ploughs and certain other agricultural implements.—Sealed May 28.

Sir Josiah John Guest, of the Dowlais iron-works, Glamorgan, baronet, and Thomas Evans, of the same place, agent, for "their invention of certain improvements in the manufacture of iron and other metals."—Sealed May 28—four months for enrolment.

Edmund Leach, of Rochdale, Lancaster, machine maker, for "certain improvements in machinery or apparatus for carding, doubling and preparing wool, cotton, silk, flax, and other fibrous substances.—Sealed May 28.

Daniel Gooch, of Paddington-green, engineer, for "certain improvements in wheels and locomotive engines, to be used on railways."—Sealed May 28.

William Henry Smith, of York-road, Lambeth, civil engineer, for "an improvement or improvements in the mode of resisting shocks to railway carriages and frames; and also in the mode of connecting and disconnecting railway carriages; also in the application of springs to carriages."—Sealed May 28.

George Henry Busill, of River-lane, Islington, gentleman, for "an improved method or methods of weighing, and certain improvements in weighing machines.—Sealed May 28.

James Allison, of Monkwearmouth, Durham, iron master, and Roger Lumsden, of the same place, chain and anchor manufacturer, for "improvements in the manufacture of iron knees, for ships and vessels."—Sealed May 30.

John Baptist Wicks, of Leicester, framework knitter, for "improvements in machinery, employed in framework knitting or stocking fabrics."—Sealed May 30.

William Pettitt, of Bradwell, Bucks, gentleman, for "a communicating apparatus to be applied to railway carriages.—Sealed May 30—two months for enrolment.

John Hawley, of Frith-street, Soho, watch maker, for "improvements in pianos and harps," being a communication.—Sealed June 1.

Pierre Defairre de Montmirail, of London-wall, gentleman, for "certain improvements in the manufacture of bread," being a communication.—Sealed June 2.

Richard Freen Martin, of Derby, gentleman, for "certain improvements in the manufacture of certain descriptions of cement."—Sealed June 2.

Samuel Salisbury Eagles, of Liverpool, engineer, for "certain improvements in obtaining motive power.—Sealed June 2.

James Harvey, of Basing-place, Waterloo-road, timber merchant, for "certain improvements in paving streets, roads, and ways, with blocks of wood, and in the machinery or apparatus for cutting or forming such blocks."—Sealed June 2.

William Southwood Stoker, of Birmingham, for "certain improvements in machinery applicable to making nails, pins, and rivets.—Sealed June 2.

Christopher Dain, of Edgbacton, Warwick, gentleman, for "certain improvements in the construction of vessels for containing and supplying ink and other fluids."—Sealed June 2.

James Roberts, of Sheffield, merchant, for "an improved mode of fastening certain kinds of horn and hoof handles to the instruments requiring the same.—Sealed June 3.

Samuel Wagstaff Smith, of Leamington, iron founder, for "improvements in apparatus for supplying and consuming gas.—Sealed June 9.

Robert Hampson, of Mayfield print works, calico printer, for "an improved method of block printing on woven fabrics of cotton, linen, silk, or woollen, or of any two or more of them intermixed, with improved machinery, apparatus, and implements, for that purpose.—Sealed June 9.

Alexander Southwood Stoker, of Birmingham, for "improvements in the manufacture of tubes for gas and other purposes.".—Sealed June 9.

Christopher Nickels, of York-road, Lambeth, gentleman, for "improvements in the manufacture of braids and plats," being a communication.—Sealed June 9.

Thomas Edmonson, of Manchester, clerk, for "certain improvements in printing presses.—Sealed June 9.

John George Shuttleworth, of Feamley-place, Glossop-road, Sheffield, gentleman, for "certain improvements in the railway and other propulsion."—Sealed June 9.

Francis Greaves, of Roaford-street, Sheffield, manufacturer of knives and forks, for "improvements in the manufacture of knives and forks."—Sealed June 11.

William Lance, of George-yard, Lombard-street, insurance broker, for "a new and improved instrument or apparatus to be used in the whale fishery, part or parts of which, upon an increased scale, are also applicable as a motive power for driving machinery."—Sealed June 11.

Benjamin Winkles, Northampton-street, Islington, copper plate manufacturer, for "certain improvements in the arrangement and construction of paddle wheels and water wheels."—Sealed June 11.

Joseph Wolverson, of Willenhall, Stafford, locksmith, and William Rawlett, of the same place, latch maker, for "certain improvements in locks, latches, and other fastenings for doors."—Sealed June 13.

Ezra Jenks Coates, of Bread-street, Cheapside, merchant, for "certain improvements in propelling canal and other boats," being a communication.—Sealed June 13.

Edward John Carpenter, of Toft Monks, Norfolk, a commander in the Royal Navy, for "improvements in the application of machinery for assisting vessels in performing certain evolutions upon the water, especially tacking, veering, propelling, steering, casting or winding, and backing astern."—Sealed June 13.

Richard Beard, of Egremont-place, New-road, gentleman, for "improvements in apparatus for taking or obtaining likenesses and representations of nature, and of drawing and other objects," being a communication.—Sealed June 13.

Richard Prosser, of Birmingham, civil engineer, and John James Rippon, of Wells-street, Middlesex, ironmonger, for "certain improvements in apparatus for heating apartments, and in apparatus for cooking."—Sealed June 17.

Richard Prosser, of Birmingham, civil engineer, for "certain improvements in manufacturing buttons from certain materials, which improvements in manufacturing are applicable, in whole or in part, to the production of knobs, rings, and other articles from the same materials."—Sealed June 17.

Thomas De la Rue, of Bunhill-row, manufacturer, for "improvements in printing calicoes and other surfaces.—Sealed June 20.

John Aitchinson, of Glasgow, merchant, and Archibald Hastie, of West-street, Finsbury-square, merchant, for "certain improvements in generating and condensing steam, heating, cooling, and evaporating fluids."—Sealed June 24.

William Hickling Burnett, of Wharton-street, Bagnigge-Wells-road, gentleman, for "improved machinery for cutting or working wood."—Sealed June 24.

William Ash, of Sheffield, manufacturer, for "certain improvements in augurs and tools for boring," being a communication.—Sealed June 24.

William Wood, of Wilton, county of Wilts, carpet manufacturer, for "certain improvements in looms for weaving carpets and other fabrics."—Sealed June 24.

Joseph Leese, jun., of Manchester, calico printer, for "certain improvements in the art of printing calicoes and other surfaces."—Sealed June 24.

THE NEW ROYAL EXCHANGE.—VIEW OF THE WESTERN FRONT.

W. TITE, ARCHITECT, F.R.S. F.G.S. &c.

London Published as the Act directs by Grattan & Gilbert 51 Paternoster Row July 31 1840

Engraved by